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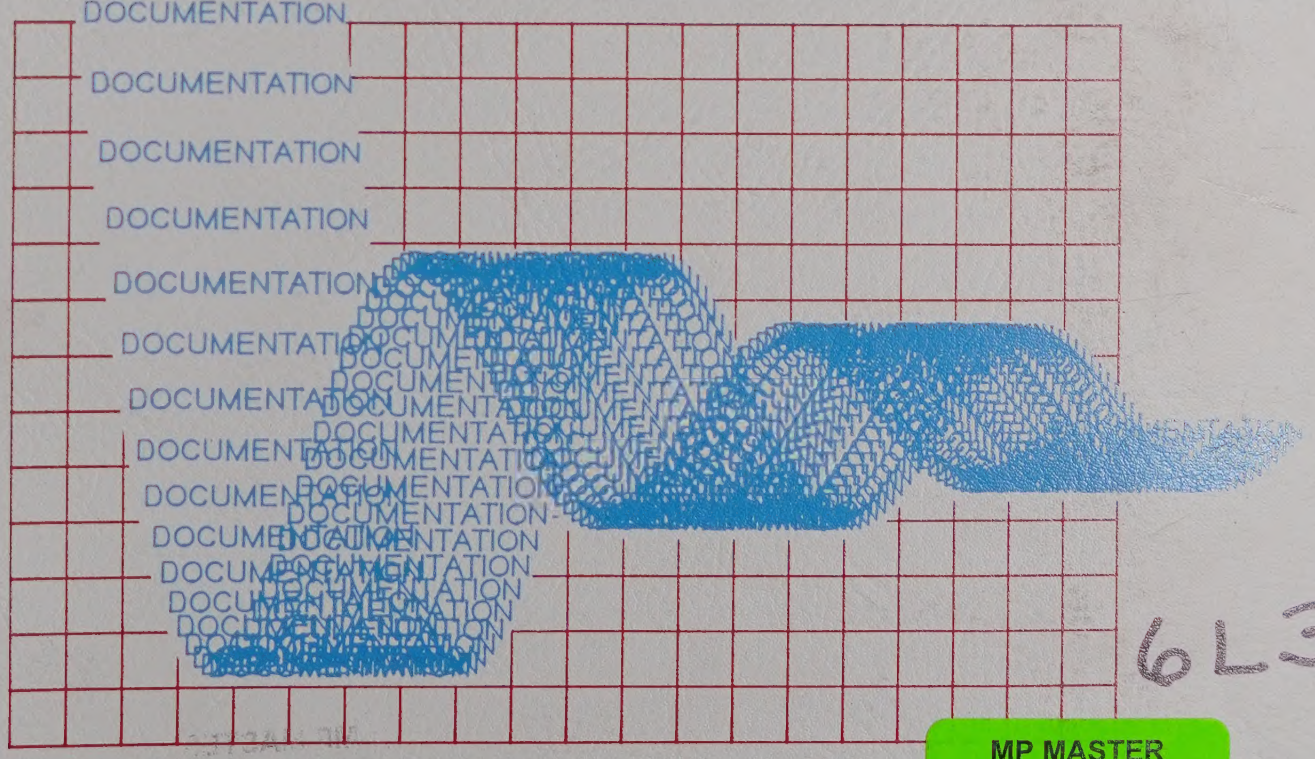

6L3

MP MASTER
MA20584

ROHDE&SCHWARZ

Test and Measurement
Division

Service Manual - Instument Level

EMI TEST RECEIVER
9 kHz to 2750 MHz

ESCS 30

~~1102.~~4500.30

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

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1 Performance Test

Test Instruments and Utilities

Item No	Type of instrument, data	Type	Order No.
1	Frequency counter up to 100 MHz Error < $1x10^{-9}$, resolution 0.1 Hz		
2	Digital multimeter, $4^1/_2$ digits	UDS5	349.1510.02
3	Signal generator 9 kHz to 2750 MHz Level: -130 to 13 dBm	SMHU	348.0010.02
4	Signal generator 9 kHz to 3710 MHz Level: -130 to 13 dBm	SMHU	348.0010.03
5	6-dB coupler, 9 kHz to 2750 MHz		
6	Reflection meter, 9 kHz to 2750 MHz		
7	50-Ω termination, 9 kHz to 2750 MHz		272.4510.50
8	Spectrum analyzer, 9 kHz..3709.4 MHz Sensitivity -127 dBm	FSEB	1066.3010.30
9	Power meter 9 kHz to 2750 MHz, Z= 50 Ω 30 to 10 dBm, error < 0.1 dB	NRV	828.2511.02
10	Pulse generator, Schwarzbeck 3 standards Pulse gen. IGUS, calibrated to < 0.1 dB	IGUS 2915	
11	Attenuator, 9 kHz to 2750 MHz Attenuation error < 0.1 dB	RSP	831.3515.02
12	RF millivoltmeter	URE 2	350.5315.02
13	Oscilloscope, f_{max} = 10 MHz		
14	Power supply 0 to 35 V, 5 A	NGB 70	177.7227.90

Test Sequence

The rated specifications of the receiver are checked after a warm-up time of at least 30 minutes and a total calibration. It is thus ensured, that the specified data are adhered to.

The values given in the following sections are not guaranteed, only the Technical Data given in the Data Sheet are binding.

Note: *The digital level values are output via IEC-bus at a resolution of 0.01 dB, thus increasing the read-off accuracy for the measurement values.*

Frequency Accuracy

Test instrument: Frequency counter, 10 MHz, error $<1x10^{-9}$

Test setup: Connect frequency counter to REF IN/OUT rear panel socket.
Settings on the ESCS:
Switch ESCS to internal reference.

Measurement: Measure frequency using frequency counter.
Rated frequency ..... 10 MHz ±10 Hz
With option ESCS-B6 ..... 10 MHz ± 5 Hz

RF Input

Input VSWR

Test instrument: Network analyzer (9 kHz to 2750 MHz)

Test setup: Connect network analyzer to the RF input of the ESCS via a low-reflection cable.

Measurement: Measure the return loss of the ESCS with the following settings:

RF attenuation	Rated return loss	
	9 kHz to 1000 MHz	1000 to 2750 MHz
0 dB	≥ 9.5 dB	≥ 7.4 dB
≥ 10 dB	≥ 20 dB	≥ 9.5 dB

Note: *A return loss of 7.4 dB corresponds to a VSWR of 2.5,*
a return loss of 9.5 dB corresponds to a VSWR of 2,
a return loss of 20 dB corresponds to a VSWR of 1.2

Oscillator Reradiation

Test instrument: Spectrum analyzer (74.7 MHz to 3709.4 MHz)

Test setup: Connect spectrum analyzer to the RF-input of the ESCS.
Setting on the receiver:
RF ATT 0 dB
Analyzer setting:
Display in dBµV
Reference level 60 dBµV
Scale 10 dB/DIV
Bandwidth 1 kHz
Mode Max Hold
Set start and stop frequency of the analyzer depending on the receiver frequency according to the following table:

ESCS-Frequency range	Start frequency	Stop frequency
9 kHz to 30.4 MHz	74.7 MHz	105.1 MHz
30.4 to 1000 MHz	1385.1 MHz	2354.7 MHz
1000 to 1900 MHz	1394.7 MHz	2294.7 MHz
1900 to 2750 MHz	1503.7 MHz	2355.3 MHz

Measurement: Slowly step through the receiver frequency in the range <30.4 MHz in steps of 5 MHz, in the range ≥30.4 MHz in steps of 25 MHz and in the range ≥1000 MHz in steps of 100 MHz, such that the level is indicated on the analyzer with each frequency. Search for the maximum value using the marker.
Level indicated on the analyzer .....< 20 dBµV

Interference Rejection

Test instrument: Signal generator (31.4 MHz to 3710 MHz)

Note: *In order not to measure the sideband noise of the transmitter, the signal-to-noise ratio of the transmitter should exceed 140 Bc/Hz. This may be obtained by connecting a highpass filter into the signal path between generator output and receiver input, if required.*

Test setup: Connect a signal generator to the RF input of the ESCS.
Level 100 dBµV

ESCS settings:
RF ATT 0dB
Mode Low Noise
Detector AV

Image Frequency of the 1st IF

Setting: Set generator frequency and IF bandwidth of the ESCS according to the table below:

ESCS frequency f_E	Generator frequency
9 kHz to 30.4 MHz	f_E+149.4 MHz
30.4 to 1000 MHz	f_E+ 2709.4 MHz
1000 to 1900 MHz	f_E+789.4 MHz
1900 to 2750 MHz	f_E-789.4 MHz

Measurement:
- Measure level P_{ind} on the receiver frequency f_E.
- The image frequency rejection is obtained from: 100 - P_{ind}/dBµV
- Level display on the receiver according to the table below:

Frequency range	Level displayed on the receiver
9 kHz to 30.4 MHz	≤ 10 dBµV
30.4 to 1000 MHz	≤20 dBµV
1000 to 1900 MHz	≤ 50 dBµV
1900 to 2750 MHz	≤ 60 dBµV

Image Frequency of the 2nd IF

Setting: Set generator frequency and ESCS frequency according to the table below:

Frequency f_E	Generator Frequency
10 MHz	31.4 MHz
100 MHz	249.4 MHz
2490 MHz	2340.6 MHz

Measurement:
- Measure level at f_E (P_{ind}).
- The image frequency rejection is obtained from: 100 – P_{ind}/dBµV
- Level display on the receiver:
  10. 100 and 2490 MHz ..... < 10 dBµV

IF Rejection

Setting: Set generator frequency and IF bandwidth of the ESCS in the three receiver ranges according to the table below:

Frequency f_E	Generator frequency	IF bandwidth
9 kHz to 30.4 MHz	74.7 MHz	10 kHz
30.4 to 1000 MHz	1354.7 MHz	10 kHz
1000 to 2750 MHz	394.7 MHz	10 kHz

Measurement:
- Measure level P_{ind} on the respective receive frequency.
- The IF rejection is obtained as follows: 100 - P_{ind}/dBµV
- Level display on the receiver according to the table below:

Frequency range	Level displayed on the receiver
9 kHz to 30.4 MHz	≤ 10 dBµV
30.4 to 1000 MHz	≤ 30 dBµV
1000 to 2750 MHz	≤ 20 dBµV

Nonlinearities

3rd-Order Intercept

Test instrument: 2 signal generators, 6-dB coupler.

Test setup: Connect signal generator to the RF input of the ESCS via the 6-dB coupler.
Level on the ESCS 97 dBµV with f_{S1} and f_{S2}
ESCS settings:

RF attenuation	0 dB
Mode	Low Noise
Detector	AV
IF-Bandwidth	120 kHz

Measurement: Set receiver frequency and generator frequencies according to the subsequent table and measure level on the respective frequencies:
The intercept IP3 is calculated using the following formula:
IP3/dBm =(97 dBµV-(level with f_E)/dBµV)/2-10 dBm
Abbreviations: f_{S1}: generator frequency 1
f_{S2}: generator frequency
2 f_E: receiver frequency

Rated value ..... > 5 dBm

f_{S1}	f_{S2}	f_E
2 MHz	3 MHz	1 MHz
2 MHz	3 MHz	4 MHz
5 MHz	6 MHz	4 MHz
5 MHz	6 MHz	7 MHz
14 MHz	15 MHz	13 MHz
14 MHz	15 MHz	16 MHz
35 MHz	45 MHz	25 MHz
35 MHz	45 MHz	55 MHz
140 MHz	150 MHz	130 MHz
140 MHz	150 MHz	160 MHz
285 MHz	295 MHz	275 MHz
285 MHz	295 MHz	305 MHz
475 MHz	485 MHz	465 MHz
475 MHz	485 MHz	495 MHz
600 MHz	610 MHz	590 MHz
600 MHz	610 MHz	620 MHz
730 MHz	740 MHz	720 MHz
730 MHz	740 MHz	750 MHz
980 MHz	990 MHz	970 MHz
980 MHz	990 MHz	1000 MHz
1120 MHz	1130 MHz	1110 MHz
1120 MHz	1130 MHz	1140 MHz
1500 MHz	1510 MHz	1490 MHz
1500 MHz	1510 MHz	1520 MHz
1870 MHz	1880 MHz	1870 MHz
1870 MHz	1880 MHz	1890 MHz
2030 MHz	2040 MHz	2020 MHz
2030 MHz	2040 MHz	2050 MHz
2470 MHz	2480 MHz	2460 MHz
2470 MHz	2480 MHz	2490 MHz
2720 MHz	2730 MHz	2710 MHz
2720 MHz	2730 MHz	2740 MHz

2nd-Order Intercept

Test instrument: Signal generator 100 kHz to 2375 MHz

Switchable lowpass filter

Test setup: Connect signal generator to the RF input of the ESCS via the lowpass which is appropriate for the respective receiver frequency (cf. table).

Level on the ESCS: 87 dBµV at f_{S1}, if $f_{S1} \leq 30$ MHz

97 dBµV at f_{S1}, if $f_{S1} > 30$ MHz

ESCS settings:

RF attenuation 0 dB
Mode Low Noise
Detector AV
IF-Bandwidth 10 kHz

Measurement: Set receiver frequency and generator frequency according to the table below and measure level on the respective frequencies. The intercept IP2 is calculated using the following formula:
IP2/dBm = (87 dBµV - (Level with f_E)/dBµV) -20 dBm, if $f_{S1} \leq 30$ MHz
IP2/dBm = (97 dBµV - (Level with f_E)/dBµV) -10 dBm, if $f_{S1} > 30$ MHz
Abbreviations: f_{S1}: generator frequency 1
f_E : receiver frequency
f_{TP}: Limit frequency of lowpass

Rated value ..... > 30 dBm

f_{S1}	f_{TP}	f_E
160 kHz	250 kHz	320 kHz
4 MHz	5 MHz	8 MHz
12 MHz	15 MHz	24 MHz
40 MHz	50 MHz	80 MHz
85 MHz	100 MHz	170 MHz
195 MHz	250 MHz	390 MHz
495 MHz	500 MHz	990 MHz
950 MHz	1000 MHz	1900 MHz

IF Bandwidths

Test instrument: Signal generator
Test setup: Connect signal generator to the RF input of the ESCS.
Level 90 dBµV
Frequency 100 MHz

ESCS settings:
Frequency 100 MHz
RF ATT Auto
Mode Low Noise
Detector AV

Measurement: Set the frequency of the receiver such that the level display indicates maximum. Measure the 6-dB and 60-dB bandwidths by means of tuning the generator frequency upward and downward according to the table below.

nominal bandwidth	6-dB bandwidth	shape factor (typ. value) B_{6dB}/B_{60dB}
200 Hz	170 to 220 Hz	1:10
10 kHz	9.5 kHz ±0.5 kHz	1:4
120 kHz	120 kHz ±10 %	1:6
1 MHz	1 MHz ±10 %	1:5

Noise Indication

Test instrument: 50-Ω termination

Test setup: Terminate RF input of the ESCS with 50 Ω.

ESCS settings:
RF ATT 0 dB
Mode Low Distortion

Meas. Time 100 ms
Detector AV

Measurement: Check the noise indication according to the table below:

Frequency range	IF BW	Noise indication without preamplifier	Noise indication with preamplifier
9 to 30 MHz	200 Hz	< -25 dBµV	< -34 dBµV
50 kHz to30 MHz	10 kHz	< -12 dBµV	< -18 dBµV
30 to 1000 MHz	120 kHz	< 1 dBµV	< - 4 dBµV
1000 to 2750 MHz	120 kHz	< 5 dBµV	< 0 dBµV

Checking the Inherent Spurious Responses

Test setup: Terminate RF input of the ESCS with 50
ESCS settings:
RF ATT 0 dB
Mode Low Distortion

Define frequency scan with the settings given in the table below:

Start	Stop	Step	IF BW	Meas. Time
9 kHz	30 MHz	50 Hz	200 Hz	100 ms
30 MHz	2750 MHz	1 kHz	10 kHz	10 ms

Setting of the level and frequency axes:
min level -20 dB
max level 40 dB
frequency axis LOG

Measurement: Start scan and plot or print the chart upon termination of scan.
The level indicated due to inherent spurious responses must not exceed the following values:
receiver frequency 9 kHz to 30 MHz ..... - 10 dBµV
receiver frequency >30 MHz .....0 dBµV

Measurement Errors

Level Measurement Error

The level measurement error of the ESCS is obtained from:

- the error of the internal calibration generator,
- the error of the RF attenuator,
- the nonlinearity of the demodulator and the log module
- the residual calibration error and
- the signal-to-noise ratio.

The total error is below 2 dB if the signal-to-noise ratio is sufficient.

Test instrument: Signal generator

Power meter

Pulse generator:
level 60 dBµV/MHz ±0.1 dB (at 100 MHz),
pulse frequency switchable (1 Hz to 1 kHz), frequency response < ±0.2 dB (9 kHz to 30 MHz)

At each frequency set, the output level of the signal generator is calibrated to the desired value (error < 0.1 dB) by means of a power meter.

Note: Prior to the measurement, the ESCS must be calibrated.

Frequency Response

Average Detector AV

Test setup: Connect signal generator to the RF-input of the ESCS.
Level 70 dBµV ±0.2 dB

ESCS settings:

RF ATT	30 dB in the range 9 kHz to 150 kHz
	10 dB in the range > 150 kHz
Mode	Low Noise
Detector	AV
IF BW	200 Hz in the range 9 kHz to 150 kHz
	10 kHz in the range > 150 kHz
Detector	AV
Meas. Time	100 ms

Measurement: Check the level measuring accuracy in the frequency range 9 kHz to 2750 MHz.
Rated value displayed (digital) .....70 dBµV
permitted error of the digital display:

Range	max. error
9 kHz to 1000 MHz	± 1 dB
1000 to 2750 MHz	± 1.5 dB

Peak Detector (Pk)

Test setup: Connect signal generator to RF input of the ESCS
Level 80 dBµV ±0.2 dB

ESCS settings:
RF ATT 10 dB
Mode Low Noise
Detector Pk
IF BW 10 kHz
Meas. Time 100 ms

Measurement: Check the level measurement accuracy with 100 MHz.
Rated display (digital) ..... 80 dBµV
permitted error of the digital display ..... ±1 dB

Quasi-Peak Detector (QP)

Error with pulses:

Test setup: Connect pulse generator to the RF input of the ESCS.
ESCS settings:
Mode Low Noise
Detector QP

Meas. Time 500 ms
Measurement: Measure level on the ESCS:

Frequency	Pulse frequency	Pulse level	RF attenuation	Display level in the range 0 to 60 dB	Rated level
100 kHz	25 Hz	114.6 dBµV/MHz	10 dB	ca. 25 dB	35 dBµV
1 MHz	100 Hz	80 dBµV/MHz	0 dB	ca. 40 dB	33.1 dBµV
100 MHz	100 Hz	60 dBµV/MHz	0 dB	ca. 20 dB	30 dBµV

Error with sinewave signals:

Test setup: Connect signal generator to the RF input of the ESCS.
Frequency1 MHz
Level 80 dBµV ±0.2 dB

ESCS settings:
Mode Low Noise
Detector QP
Meas. Time 100 ms

Measurement: Measure level on the ESCS
Rated value ..... 80 dBµV

Frequency	RF attenuation	Display level in the range from 0...60 dB	Tolerance
100 kHz	40 dB	ca. 60 dB	±1.5 dB
1 MHz	20 dB	ca. 60 dB	±1.5 dB
100 MHz	10 dB	ca. 60 dB	±1.5 dB

Quasi-peak weighting curve:

Band A:

Test setup: Connect pulse generator to the RF input of the ESCS.

ESCS settings:
Frequency 100 kHz
RF attenuation 10 dB
Mode Low Noise
Meas. Time 2 s

Measurement: Measure level on ESCS depending on the pulse frequency of the pulse generators according to the table below. The reference value is the level at a pulse frequency of 25 Hz.

Pulse frequency	Rated level	Rated value of weighting	Tolerance
25 Hz	35 dBµV	(Ref.)	-
100 Hz	39 dBµV	+4 dB	±1 dB
60 Hz	38 dBµV	+3 dB	±1 dB
10 Hz	31 dBµV	-4 dB	±1 dB
5 Hz	27.5 dBµV	-7.5 dB	±1.5 dB
2 Hz	22 dBµV	-13 dB	±2.0 dB
1 Hz	18 dBµV	- 17 dB	±2.0 dB
Single pulse	16 dBµV	- 19 dB	±2.0 dB

Band B:

Test setup: Connect pulse generator to the RF input of the ESCS.

ESCS settings:
Frequency 1 MHz
RF attenuation 0 dB
Mode Low Distortion
Op. Range 60 dB
Meas. Time 2 s

Measurement: Measure level on the ESCS depending on the pulse frequency of the pulse generator according to the table below. The reference value is the level at a pulse frequency of 100 Hz.

Pulse frequency	Rated level	Rated value of weighting	Tolerance
100 Hz	33 dBµV	(Ref.)	-
20 Hz	26.5 dBµV	-6.5 dB	±1 dB
10 Hz	23 dBµV	-10 dB	±1.5 dB
2 Hz	12.5 dBµV	-20.5 dB	±2.0 dB
1 Hz	10.5 dBµV	-22.5 dB	±2.0 dB
Single pulse	9.5 dBµV	-23.5 dB	±2.0 dB

Band C/D:

Test setup: Connect pulse generator to the RF input of the ESCS.
Level 80 dBµV/MHz

ESCS settings:

Frequency	100 MHz
RF-attenuation	0 dB
Mode	Low Distortion
Detector	QP
Op Range	60 dB
Meas. Time	2 s

Measurement: Measure level on the ESCS depending on the pulse frequency of the pulse generator.
The level with a pulse frequency of 100 Hz is the reference level

Pulse frequency	Rated level	Rate level of weighting	Tolerance
100 Hz	50.0 dBµV	(Ref.)	-
20 Hz	41.0 dBµV	-9.0 dB	±1 dB
10 Hz	36 dBµV	-14.0 dB	±1.5 dB
2 Hz	24.0 dBµV	-26.0 dB	±2.0 dB
1 Hz	21.5 dBµV	-28.5 dB	±2.0 dB
Single pulse	18.5 dBµV	-31.5 dB	±2.0 dB

Display Linearity

Test instrument: Signal generator

Attenuator, attenuation corrected
max. permitted error < 0.1 dB

Test setup: Connect signal generator to the RF input of the ESCS via an attenuator.
Level of signal generator 83 dBµV
Residual attenuation of attenuator 3 dB

ESCS settings:

Frequency	100 MHz	
RF ATT	20 dB mode	Low Noise
Detector	AV	
IF BW	10 kHz	
Meas. Time	100 ms	

Measurement:

- Set signal generator level such that the ESCS shows full-scale deflection (80 dBµV)
- Increase the attenuation value of the attenuator from 3 dB to 63 dB in 5 dB-steps and measure the level for each attenuation value. The level indicated is reduced by 5 dB at each step.
  Permitted error ..... ≤ 0.5 dB

Error of the Attenuator

Test instrument: Signal generator

Attenuator, attenuation corrected
max. permitted error < 0.2 dB

Test setup: Connect signal generator to the RF input of the ESCS via an attenuator.
Level of the signal generator 110 dBµV
Attenuation of the attenuator 70 dB

ESCS settings:

RF-attenuation	10 dB
IF BW	10 kHz
Mode	Low Distortion
Detector	AV
Meas. Time	100 ms
Preamp.	OFF
Frequency	100 MHz and 2200 MHz

Measurement:

- Set the level on the signal generator such that the ESCS indicates 40.0 dBµV.
- Set the attenuator to 70 dB and the RF attenuation of the ESCS to 0 dB.
- Then, reduce the attenuation in steps of 5 dB to 10 dB.
- Simultaneously, increase the RF attenuation of the ESCS in steps of 5 dB.
- Measure level display with the respective settings
  Rated level: ..... 40 dBµV + RF-attenuation set
  permitted attenuation error.....≤ 0.7 dB in the range 9 kHz to 1000 MHz
  .....≤ 1 dB in the range 1000MHz to 2750 MHz

IF Analysis (Option ESCS-B4)

Amplification and Linearity

Test instrument: Signal generator

Attenuator

Test setup: Connect signal generator to the RF-input of the ESCS via attenuator.

Level	80 dBµV ± 0.1 dB
Frequency	5.9 MHz
Attenuation of the attenuator	10 dB

ESCS settings:

RF ATT	10 dB
Frequency	5.9 MHz

IF Analysis:

Span	10 kHz
Res. BW	1 kHz
Sweep Time	100 ms
Attenuation	0 dB
Marker	Peak

Measurement:

- The marker level is 70 dBµV
- Increase attenuation value of the attenuator to 80 dB in 10-dB steps.
- Measure marker level for each setting.
  Rated level: ..... 80 dBµV - attenuation set
  Permitted error ..... ≤ 2.5 dB

20-dB-IF-Input Attenuation

Test instrument: Signal generator

Attenuator

Test setup: Connect signal generator to the RF-input of the ESCS via attenuator.

Level	100 dBµV ± 0.1 dB
Frequency	5.9 MHz
Attenuation	30 dB

ESCS settings:

RF ATT	10 dB
Frequency	5.9 MHz

IF Analysis:

Span	10 kHz
Res. BW	1 kHz
Sweep Time	100 ms
Attenuation	0 dB
Marker	Peak

Measurement:

- Measure marker level (P_{0dB}).
- Set attenuation to 20 dB in the menu IF Analysis to 20 dB. Set attenuation value of the attenuator to 10 dB.
- Measure marker level(P_{20dB}).

The error of the input attenuation is calculated according to: $F_{20dB} = P_{0dB} - P_{20dB}$
Permitted error ..... ≤ 0.5 dB

Resolution Bandwidths

Test instrument: Signal generator

Test setup: Connect signal generator to the RF-input of the ESCS via attenuator.

Level	70 dBµV ± 0.1 dB
Frequency	5.9 MHz

ESCS settings:

RF ATT	10 dB
Frequency	5.9 MHz

IF Analysis:

Span	10 kHz
Sweep Time	100 ms
Attenuation	0 dB
Marker	Peak

Measurement:

- The following measurements must be carried out for the resolution bandwidths 10 kHz, 3 kHz and 1 kHz:
- Measure marker level (P_{Middle}).
- Increase signal generator level by 3 dB ± 0.1 dB.
- Adjust receiver frequency to lower values until the maker level P_{Middle} ± 0.1 dB is reached . Frequency = f_{3dB-}.
- Adjust receiver frequency to higher values until the maker level P_{Middle} ± 0.1 dB is reached. Frequency = f_{3dB+}.
- The 3-dB-bandwidth is $B_{3dB} = f_{3dB+} - f_{3dB-}$.
  Check nominal values according to the following table:

Nominal bandwidth	Min. Value	Max. Value
10 kHz	8 kHz	12 kHz
3 kHz	2.4 kHz	3.6 kHz
1 kHz	0.8 kHz	1.2 kHz

Shape Factor of the IF-Filters

Test instrument: Signal generator

Test setup: Connect signal generator to the RF-input of the ESCS via attenuator.

Level	70 dBµV ± 0.1 dB
Frequency	5.9 MHz

ESCS settings:

RF ATT	10 dB
Frequency	5.9 MHz

IF Analysis:

Span	50 kHz
Sweep Time	20 ms
Attenuation	0 dB
Marker	Peak

Measurement:

- The following measurements must be carried out for the resolution bandwidths of 10 kHz, 3 kHz and 1 kHz:
- Measure marker level (P_{Middle}).
- Adjust receiver frequency to lower values until the maker level P_{Middle} - 60 dB ± 0.5 dB is reached. Frequency = f_{60dB-}.
- Adjust receiver frequency to higher values until the maker level P_{Middle} - 60 dB ± 0.5 dB is reached. Frequency = f_{60dB+}.
- The 60-dB-bandwidth is $B_{60dB} = f_{60dB+} - f_{60dB-}$.
  Check nominal values according to the following table:

Bandwidth	Shape Factor 3:60 dB
10 kHz	< 4
3 kHz	< 6
1 kHz	< 9

Testing the Outputs

AF OUTPUT

Test instrument: Signal generator

Oszilloscope

Test setup: Connect signal generator to the RF input of the ESCS.

Frequency	100 MHz, 30 %-AM- modulated, AF = 1 kHz
Level	80 dBµV

Connect oscilloscope to the RF output of the ESCS via jack plug.

Settings on the ESCS :

Frequency	100 MHz
RF ATT	20 dB
Mode	Low Noise
Detector	AV
IF BW	10 kHz
Meas. Time	100 ms

Measurement: Set voltage on the oscilloscope such that visible distortions just do not occur, using the volume control.
Voltage to be set ..... > 2 V

10.7 MHz OUTPUT

Test instrument: Signal generator

RF millivoltmeter (ac)

Test setup: Connect signal generator to the RF input of the ESCS.

Frequency	100 MHz
Level	80 dBµV ±0.2 dB

Connect RF millivoltmeter to the 10.7-MHz output on the rear panel of the ESCS

ESCS settings:

Frequency	100 MHz
RF ATT	20 dB
Detector	AV
IF BW	10 kHz
Mode	Low Noise

Measurement: Measure the output level (EMK) using the RF millivoltmeter.
Rated value: ..... typ. 1000 mV

10-MHz-Reference Output (REF IN/OUT)

Test instrument: RF-Millivoltmeter (AC)

Test setup:
- Connect RF-millivoltmeter to the 10 MHz-reference output (REF IN/OUT) on the rear panel of the ESCS via a 50 Ω-lead-through termination.
- Switch ESCS to internal reference.

Measurement: Measure output level using the RF-millivoltmeter.
Rated value: ..... > 6 dBm

User Port Analog Output

Test instrument: Signal generator

Digital voltmeter

Test setup: Connect signal generator to the RF-input of the ESCS

Frequency	100 MHz
Level	80 dBµV ±0.2 dB
ESCS settings:	
Frequency	100 MHz
RF ATT	20 dB
Mode	Low Noise
IF BW	9 kHz
Preamp.	OFF
Transducer	OFF

Measurement

➢ Connect digital voltmeter to the USER PORT between pin 24 (gnd) and pin 23 (recorder 1).
Voltage on DVM ..... 3.75 V
permitted error..... 100 mV

➢ Set signal generator level to 20 dBµV ± 0.2 dB.
Voltage on DVM ..... 0.75 V
permitted error ..... 100 mV

Testing the Inputs

Checking the External Reference

Test instrument: Signal generator

Test setup: Connect signal generator to the REF IN/OUT connector.

Frequency	10 MHz
Level	-7 dBm

Measurement: Switch ESCS to external reference.
Switch off signal generator level.
The ESCS displays the message CHECK EXT REF:
Switch off the external reference.

Checking the External Battery Supply

Test instrument: Checking the External Battery Supply

Digital voltmeter

Test setup: Connect power supply to the EXT-BATT input of the ESCS.
Voltage 12 V

Measurement:

➢ Switch on ESCS.
The receiver switches on.

➢ Vary voltage between 11 and 33 volts.

The ESCS remains switched on.

➢ Reduce voltage on the power supply.
The ESCS switches off when the voltage is..... 11 V ±0.2 V

Note: *When increasing the supply voltage, an instrument reset may occur with approx. 15.5 V and with approx. 14.5 V when decreasing the voltage.*

Checking the Antenna Code Socket

Test instrument: Digital voltmeter

Test setup: ESCS settings:

RF ATT	10 dB
IF BW	10 kHz
Mode	Low Distortion
Detector	AV

Measurement:

➢ Connect X3/C to X3/A.
The unit in the level display changes from dBµV to dBµV/m.

➢ Connect X3/D to X3/A.
The unit in the level display changes from dBµV to dBµA.

➢ Connect X3/F to X3/A.
The zero scale deflection changes from 0 to 20 dB.

➢ Connect X3/F to X3/A.
The zero scale deflection changes from 0 to 20 dB.

➢ Connect X3/G to X3/A.
The zero scale deflection changes from 0 to 40 dB

➢ Connect X3/H to X3/A.
The zero scale deflection changes from 0 to 80 dB.

➢ Connect X3/E and X3/M to X3/A.
The zero scale deflection changes from 0 to -10 dB.

Item No.	Characteristic	Min.-value	Actual value	Max. value	Unit
9	Noise indication Detector AV Preamplifier off IF BW 200 Hz				
	9 kHz	-		-25	dBµV
	50 kHz	-	_____	-25	dBµV
	100 kHz	-	_____	-25	dBµV
	1 MHz	-	_____	-25	dBµV
	3 MHz	-	_____	-25	dBµV
	7 MHz	-	_____	-25	dBµV
	10 MHz	-	_____	-25	dBµV
	21 MHz	-	_____	-25	dBµV
	30 MHz	-	_____	-25	dBµV
			_____		
	IF BW 10 kHz				
	50 kHz	-		-12	dBµV
	100 kHz	-	_____	-12	dBµV
	1 MHz	-	_____	-12	dBµV
	3 MHz	-	_____	-12	dBµV
	7 MHz	-	_____	-12	dBµV
	10 MHz	-	_____	-12	dBµV
	21 MHz	-	_____	-12	dBµV
	30 MHz	-	_____	-12	dBµV
			_____		
	IF BW 120 kHz				
	30 MHz	-		1	dBµV
	70 MHz	-	_____	1	dBµV
	100 MHz	-	_____	1	dBµV
	180 MHz	-	_____	1	dBµV
	250 MHz	-	_____	1	dBµV
	450 MHz	-	_____	1	dBµV
	600 MHz	-	_____	1	dBµV
	950 MHz	-	_____	1	dBµV
	1050 MHz	-	_____	5	dBµV
	1850 MHz	-	_____	5	dBµV
	1950 MHz	-	_____	5	dBµV
	2500 MHz	-	_____	5	dBµV
	2750 MHz	-	_____	5	dBµV
10	Noise indication Detector AV Preamplifier on IF BW 200 Hz				
	9 kHz	-	_____	-34	dBµV
	50 kHz	-	_____	-34	dBµV
	100 kHz	-	_____	-34	dBµV
	1 MHz	-	_____	-34	dBµV
	3 MHz	-	_____	-34	dBµV
	7 MHz	-	_____	-34	dBµV
	10 MHz	-	_____	-34	dBµV
	21 MHz	-	_____	-34	dBµV
	30 MHz	-	_____	-34	dBµV
	IF BW 10 kHz				
	50 kHz	-	_____	-18	dBµV
	100 kHz	-	_____	-18	dBµV
	1 MHz	-	_____	-18	dBµV
	3 MHz	-	_____	-18	dBµV
	7 MHz	-	_____	-18	dBµV
	10 MHz	-	_____	-18	dBµV
	21 MHz	-	_____	-18	dBµV
	30 MHz	-	_____	-18	dBµV

Item No.	Characteristic	Min.-value	Actual value	Max. value	Unit
10	IF BW 120 kHz				
	30 MHz	-	_____	-4	dBµV
	70 MHz	-	_____	-4	dBµV
	100 MHz	-	_____	-4	dBµV
	180 MHz	-	_____	-4	dBµV
	250 MHz	-	_____	-4	dBµV
	450 MHz	-	_____	-4	dBµV
	600 MHz	-	_____	-4	dBµV
	950 MHz	-	_____	-4	dBµV
	1050 MHz	-	_____	0	dBµV
	1850 MHz	-	_____	0	dBµV
	1950 MHz	-	_____	0	dBµV
	2500 MHz	-	_____	0	dBµV
	2750 MHz	-	_____	0	dBµV
11	Spurious responses				
	9 kHz to 30 MHz	-	_____	- 10	dBµV
	30 MHz to 2750 MHz	-	_____	0	dBµV
12	Meas. error				
	Frequency response				
	Detector AV				
	9 kHz	69	_____	71	dBµV
	149 kHz	69	_____	71	dBµV
	150 kHz	69	_____	71	dBµV
	1 MHz	69	_____	71	dBµV
	3 MHz	69	_____	71	dBµV
	7 MHz	69	_____	71	dBµV
	10 MHz	69	_____	71	dBµV
	21 MHz	69	_____	71	dBµV
	30 MHz	69	_____	71	dBµV
	70 MHz	69	_____	71	dBµV
	100 MHz	69	_____	71	dBµV
	180 MHz	69	_____	71	dBµV
	250 MHz	69	_____	71	dBµV
	450 MHz	69	_____	71	dBµV
	600 MHz	69	_____	71	dBµV
	950 MHz	69	_____	71	dBµV
	1050 MHz	68.5	_____	71.5	dBµV
	1850 MHz	68.5	_____	71.5	dBµV
	1950 MHz	68.5	_____	71.5	dBµV
	2500 MHz	68.5	_____	71.5	dBµV
	2750 MHz	68.5	_____	71.5	dBµV
13	Meas. error				
	Detector: Pk				
	100 MHz	79	_____	81	dBµV

Item No.	Characteristic	Min.-value	Actual value	Max. value	Unit
14	Meas. error				
	Detector: QP				
	100 kHz	33	_____	37	dBµV
	1 MHz	31.1	_____	35.1	dBµV
	100 MHz	28	_____	32	dBµV
	Detector: QP				
	100 kHz	78.5	_____	81.5	dBµV
	1 MHz	78.5	_____	81.5	dBµV
	100 MHz	78.5	_____	81.5	
	Frequency: 100 kHz				
	Pulse frequency:				
	25 Hz	35	_____	35	dBµV
	100 Hz	38	_____	40	dBµV
	60 Hz	37	_____	39	dBµV
	10 Hz	30	_____	32	dBµV
	5 Hz	26	_____	29	dBµV
	2 Hz	20	_____	24	dBµV
	1 Hz	16	_____	20	dBµV
	Single pulse	14	_____	18	dBµV
	Frequency: 1 MHz				
	Pulse frequency:				
	100 Hz	33.0	_____	33.0	dBµV
	1000 Hz	36.5	_____	38.5	dBµV
	20 Hz	25.5	_____	27.5	dBµV
	10 Hz	21.5	_____	24.5	dBµV
	2 Hz	10.5	_____	14.5	dBµV
	1 Hz	8.5	_____	12.5	dBµV
	Single pulse	7.5	_____	11.5	dBµV
	Frequency: 100 MHz				
	Pulse frequency:				
	100 Hz	50.0	_____	50.0	dBµV
	1000 Hz	57.0	_____	59.0	dBµV
	20 Hz	40.0	_____	42.0	dBµV
	10 Hz	34.5	_____	37.5	dBµV
	2 Hz	21.5	_____	25.5	dBµV
	1 Hz	19.5	_____	23.5	dBµV
	Single pulse	16.5	_____	20.5	dBµV
15	Display linearity				
	Digital display.				
	IF BW: 10 kHz				
	60-dB-range				
	Attenuation				
	3 dB		80.0		
	8 dB	74.5	_____	75.5	dBµV
	13 dB	69.5	_____	70.5	dBµV
	18 dB	64.5	_____	65.5	dBµV
	23 dB	59.5	_____	60.5	dBµV
	28 dB	54.5	_____	55.5	dBµV
	33 dB	49.5	_____	50.5	dBµV
	38 dB	44.5	_____	45.5	dBµV
	43 dB	39.5	_____	40.5	dBµV
	48 dB	34.5	_____	35.5	dBµV
	53 dB	29.5	_____	30.5	dBµV
	58 dB	24.5	_____	25.5	dBµV
	63 dB	19.5	_____	20.5	dBµV

Item No.	Characteristic	Min.-value	Actual value	Max. value	Unit
16	Attenuator Error Frequency: 100 MHz Attenuation:				
	0 dB	-	40.0	-	dBµV
	5 dB	44.3	_____	45.7	dBµV
	10 dB	49.3	_____	50.7	dBµV
	15 dB	54.3	_____	55.7	dBµV
	20 dB	59.3	_____	60.7	dBµV
	25 dB	64.3	_____	65.7	dBµV
	30 dB	69.3	_____	70.7	dBµV
	35 dB	74.3	_____	75.7	dBµV
	40 dB	79.3	_____	80.7	dBµV
	45 dB	84.3	_____	85.7	dBµV
	50 dB	89.3	_____	90.7	dBµV
	55 dB	94.3	_____	95.7	dBµV
	60 dB	99.3	_____	100.7	dBµV
	Frequ.: 2200 MHz Attenuation:				
	0 dB		40.0		dBµV
	5 dB	44	_____	46	dBµV
	10 dB	49	_____	51	dBµV
	15 dB	54	_____	56	dBµV
	20 dB	59	_____	61	dBµV
	25 dB	64	_____	66	dBµV
	30 dB	69	_____	71	dBµV
	35 dB	74	_____	76	dBµV
	40 dB	79	_____	81	dBµV
	45 dB	84	_____	86	dBµV
	50 dB	89	_____	91	dBµV
	55 dB	94	_____	96	dBµV
	60 dB	99	_____	101	dBµV
17	IF-Analysis Attenuation Marker level		70		dBµV
	Linearity: RF-Attenuation				
	20 dB	58.5	_____	62.5	dBµV
	30 dB	48.5	_____	52.2	dBµV
	40 dB	38.5	_____	42.5	dBµV
	50 dB	28.5	_____	32.5	dBµV
	60 dB	18.5	_____	22.5	dBµV
	70 dB	8.5	_____	12.5	dBµV
18	IF-Analysis Input attenuation Error		_____	0.5	dB
19	IF-Analysis Resol. bandwidths 3-dB-bandwidth				
	10 kHz	8	_____	12	kHz
	3 kHz	2.4	_____	3.6	kHz
	1 kHz	0.8	_____	1.2	kHz
	Shape factor				
	10 kHz	-	_____	4	-
	3 kHz	-	_____	8	-
	1 kHz		_____	9	-
20	AF-output	1.5	_____	-	V

Item No.	Characteristic	Min.-value	Actual value	Max. value	Unit
21	10.7 MHz-output	800	_____	1200	mV
22	Reference output	6	_____	-	dBm
22	User Port Recorder 1	 3.65 0.65	 _____ _____	 3.85 0.85	 V V

2 Adjustment

Test Instruments and Utilities

Pos. No.	Type of equipment, specifications required	Type	Order-No.
1	Frequency counter up to 100 MHz Error < $1x10^{-9}$, resolution 0,1 Hz		

Test and Adjustment of the Frequency Accuracy

The frequency accuracy of the reference oscillator must be tested once in a year according to Section 1. If required, a readjustment can be performed only after a warm-up time of at least 30 minutes. This is done by means of a service function. The setting value is stored in the CMOS-Ram.

- Connect frequency counter (Error < $1x10^{-9}$) to the REF IN/OUT socket on the rear panel.
- Press CONFIG key.
  The CONFIG menu is displayed on the screen.
- Activate *SETUP* softkey.
  The SETUP menu is displayed.
- Switch over to internal reference with the *REF FREQ* softkey.
- Press CONFIG key.
- Use *SERVICE MENU* to open the SERVICE MENU.
- Call *REF FREQ ADJ* service function by means of the cursor keys, or by entering the number of the service function.
- Use *EDIT* softkey to open the entry window. The current setting value is displayed (Value range: -2048 to +2047).
- Adjust reference frequency to 10 MHz ±10 Hz (±5 Hz with option ESCS-B6) by means of the cursor keys, or by entering the numeric value.

The new value is stored in the CMOS-Ram by pressing the *ENTER* key.

3 Repair

Function Description

(See circuit diagram 1102.4500.01S, sheets 1 to 6)

Instrument Function

The ESCS is a triple-heterodyne EMI test receiver.

- Frequency range of instrument: 9 kHz to 2750 MHz

Irrespective of the frequency range, signal processing takes place in

- 3 RF/IF and weighting boards
- 1 synthesizer board
- 1 controller board.

Description of the Block Diagram

Frontend (A110)

The RF signal is taken from the input socket RF INPUT on the front panel via the MEAS/CAL switch for feeding in the calibration generator signal to the 60-dB attenuator that can be switched in 5-dB steps. The switch, the attenuator and the cal generator are included in the board. This is followed by a triple separating filter for splitting up the signal and 2 fixed-tuned and 8 tunable preselection filters. Except for the frequency range 9 to 150 kHz that is switched over by means of relays all the other filters are switched on via PIN switches. The filter tuning voltages are generated via D/A converters with data individually recorded for each board and stored in 2 OTPROMs. In the filter ranges above 500 MHz, the signal level is amplified by 3 preamplifiers.

A switchable preamplifier is located between the preselection and the 1st mixer.

The frequency range below 30.4 MHz is converted to the 1st IF of 74.7 MHz with the LO signal divided by 20 from the SYNTHESIZER UNIT. The 1st mixer is followed by the 1st IF amplifier and an IF filter.

The frequency range 30.4 to 1000 MHz is converted in the 1st mixer to the 1st IF of 1354.7 MHz with the LO signal 1354.7 to 2354.7 MHz from the SYNTHESIZER UNIT. The 1st IF amplifier is followed by 2 3-pole IF filters that are decoupled by a buffer amplifier.

The frequency range above 1000 MHz ist down-converted to the 1st IF of 394.7 MHz with the same LO signal. This is followed by the 1st IF amplifier 394.7 MHz.

The cal generator that is also integrated in the frontend contains 2 pulse generators for frequency response calibration in the ranges from 9 kHz to 30 MHz and from 30 to 2750 MHz as well as for calibration of the QP detectors. The individually measured frequency responses of the generators are also stored in the OTPROMs.

Synthesizer Unit (A120)

The Synthesizer Unit contains the complete conditioning of all LO signals and the reference generation. To this end, the receiver-internal reference frequency of 64 MHz is generated first from the internal 10-MHz TCXO (OCXO with Option ESCS-B6) or an externally applied 10-MHz reference signal in a PLL. This reference frequency is simultaneously used as 3rd LO. In a further PLL circuit, the 2nd LO of 1280 MHz (for receive frequencies up to 1 GHz) or 320 MHz (for receive frequencies above 1 GHz) is generated. The 1st LO is generated in a fractional-N-loop synthesizer.

In addition, the board contains 2 three-pole filters that are decoupled via a buffer amplifier for processing of the 394.7-MHz IF, the 2nd mixer for conversion to the 2nd IF of 74.7 MHz and a 74.7-MHz IF amplifier.

2nd Mixer (A130)

On the 2nd mixer board, the 1st IF of 1354.7 MHz is amplified first before being converted to the next IF of 74.7 MHz in the 2nd mixer. The switch for the IF signal from the frequency range above 1 GHz is followed by an LC filter with a bandwidth of 10 MHz and a low-noise amplifier. Then follows the conversion to the 3rd IF of 10.7 MHz.

IF Selection Board (A170)

The 10.7-MHz IF signal is taken via the 4th IF amplifier to the main selection filters 1 MHz, 120 kHz, 10 kHz and 200 Hz that can be switched over via analog switches. The signal level at the board input is monitored by an overload detector. The IF attenuation is set in four 10-dB steps at 2 cascaded amplifiers. The gain of the subsequent calibration amplifier can be varied by ±6 dB using a 10-bit D/A converter that is controlled by the CPU board. Thus the total gain is readjusted to the nominal value, taking into account the correction values determined in the level calibration. For servicing purposes, the correction values can be switched off and the calibration amplifier set manually. As noise filters, switchable via analog switches, a two-pole crystal filter with a bandwidth of 16 kHz and an LC filter with a bandwidth of 1.8 MHz are used. They are connected via a 12-dB buffer amplifier to the active envelope detector and the output for the audio path on the detector board.

Detector Board (A180)

The output signal of the envelope detector on the IF selection board is first taken to the average-value lowpass with 4 switchable time contstants, the quasi-peak detector with the weighting curves to CISPR A/B/C/D and subsequent meter simulation, the linear peak detector and the rms detector (if Option ESCS-B9 is fitted). Via the selector switch for selecting the type of weighting, the DC voltage is taken to the temperature-compensated logarithmic amplifier. Then, the displayed signal is applied to a buffer stage for decoupling the boards outputs. For transducer correction of the analog meter, a dc voltage is added that is controlled by the CPU board via a D/A converter. The board also contains the audio demodulators for the modulation modes A3, A0 and F3.

IF Analysis (A190), Option ESCS-B4

The input signal in the range 74.7 MHz ± 5 MHz or ± 1 MHz in the RF range from the 2nd mixer first passes a 2-MHz bandpass which is bridged for input frequencies > 30 MHz and then reaches the 0/20 dB input attenuator implemented with PIN diodes. The LO signal 77.6 to 87.6 MHz for the subsequent mixer is generated in a fractional-N PLL. The 7.9-MHz IF signal is taken via an amplifier to the three switchable crystal filters with the bandwidths 1, 3 and 10 kHz. Two further amplifiers and the noise filter with a bandwidth of 20 kHz are followed by the integrated IF log amplifier. The video filter provides the video signal for further processing in the PC 104 graphics computer.

Tracking Generator (A100), Option ESCS-B5

Using two PLLs, a signal in the range from 1000 to 2600 MHz and a signal at 1536 MHz are generated. By means of conversion, an IF signal in the range from 9 kHz to 1000 MHz is produced. The signal in the range from 1000 to 2600 Mhz is directly generated by the synthesizer. Above 2600 MHz, the signal is obtained from a frequency doubler. A level control makes sure that a constant output level of -17 dBm is provided over the complete frequency range.

Serial Board Control

In all synthesizer and signal-processing boards of the ESCS, a serial bus concept is used for control. The advantages of this concept are a higher flexibility and reliability due to considerable reduction of the number of connections. Addressing of the board and data transmission are effected via a 3-wire bus consisting of clock, data and strobe line. Each board is assigned at least one address. Fig. 3-1 illustrates the data format used.

- The first 4 bits of the first byte transferred trigger the board selftest.
- The last byte transferred is the address byte used to select the relevant board.

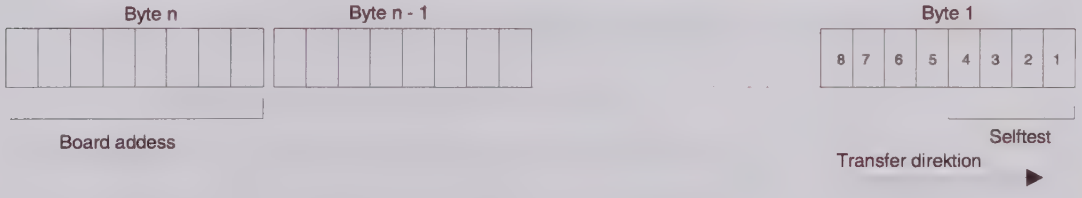


Fig. 3-1 Data format of serial board control

Fig. 3-2 shows an example of the circuit section for address decoding and serial/parallel conversion of the control signals provided on each board.

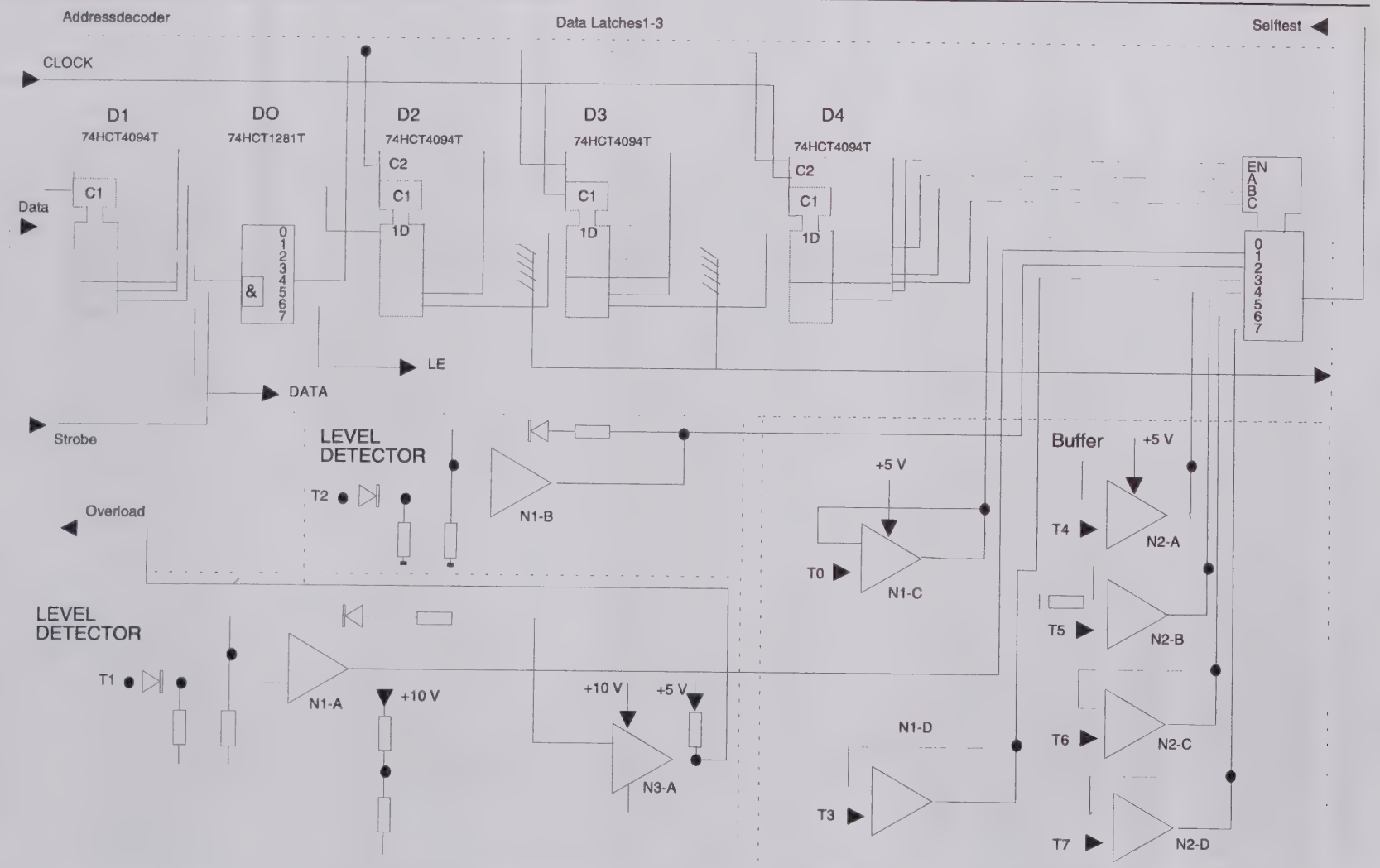


Fig. 3-2 Example of circuit for address decoding. Serial/parallel conversion of control signals and polling of selftest points

All data sent are clocked into the shift registers D_2 to D_n on all boards. The byte transmitted last and stored in register D1 is evaluated as address by decoder D0.

When the strobe signal is sent after termination of the serial data transfer, only the shift registers D2 to Dn of the addressed board load the setting data into their output registers.

The Synthesizer and Tracking Generator boards accommodate programmable dividers and D/A converters with integrated data registers. They are addressed with their own address by means of decoder D0 provided on the board (outputs LE and data in Fig. 3-2).

Monitoring the Functioning and Selftest

The ESCS is equipped with comprehensive monitoring and selftest facilities that permit extensive checking of the receiver functions. In the case of a fault, the instrument is capable of locating the faulty board automatically. Exactly defined board interfaces permit the boards to be replaced without the need for individual adjustment. Matching to the complete receiver that may then be necessary is effected under menu control, using the internal calibration calibator so that no additional measuring equipment is required.

The receiver functions are checked at 4 levels:

- Automatic test of the processor functions and adjustment of the A/D converter after the instrument has been switched on.
- Test of all controller functions on cold start of the instrument.
- Permanent monitoring of synthesizer and power supply during operation.
- Function check of the complete receiver (computer, synthesizer, signal unit) by calling up the selftest manually.

Switch-on Test

After the instrument has been switched on, the selftest of the processor functions is performed first. This is followed by a rough function test of the CMOS RAM by polling the contents of a memory location. In the following initialization of the analog boards, proper functioning of the interface for the serial board control is checked. The function test and self-adjustment of the A/D converter terminate the switch-on test of the ESCS.

Cold Start

With the cold start of the receiver, an extended test of the CPU board is performed. It is triggered by pressing the key "." in the numerical keypad while the ESCS is switched on.

In the case of the cold start, the program memory (EPROM), the static (CMOS RAM) and the volatile data memory (DRAM), the IEC bus and the interfaces to the remaining boards are tested after switch-on in addition to the normal test. When a fault is found, the message *ERR: CPU* is output on the frequency display. The receiver can no longer be operated.

Since not all instrument functions access to all function units of the controller board, further operation of the receiver may be possible nevertheless. In this case, it is possible to call up the selftest after switching the ESCS off and on again in order to obtain some detailed hint on the faulty function unit.

Caution: *The cold start deletes all internally stored data such as limit lines and transducer factors and restores the default settings..*

Service and Selftest Functions

The selftest permits to check the functioning of the instrument without additional measuring equipment. If an instrument error occurs, the board that has caused the fault is indicated on the screen. Locating of the fault with the aid of the selftest functions is achieved as follows:

Every synthesizer and signal board contains one or two 1-out-of-8 analog multiplexers, to which max. 16 test voltages are applied via buffer operational amplifiers (N1 and N2 in Fig. 3-2). Various functions can be monitored:

- Supply voltages generated in the board
- DC operating points of amplifiers and oscillators
- Signal levels with the aid of level detectors in the signal path
- Mixer oscillator level with the aid of LO level detectors

The test channel is selected via the serial board control. All test outputs of the board are combined to form a single line (output selftest in Fig. 3-2). A switch is located at the input of the A/D converter on the CPU board, where the selected test voltage is applied via a buffer operational amplifier and measured in test mode. All instrument setups required for checking a test function are made automatically.

In order to avoid irrelevant error messages, proper working of all functions of a subordinate function level must be checked before a higher function level can be analyzed. Therefore, only one fault can be detected. The order of the tests results from the hierarchy of functions in the instrument.

A distinction is to be made between

- permanent selftest functions
- the user selftest and
- the service test.

Permanent Selftest

The permanent selftest monitors the synthesizer loops and the operating voltages in the power supply.

Monitoring the Synthesizer Loops

All synthesizer loops in the instrument are checked to make sure that the control voltages lie within the permissible range. If this is not the case, a processor interrupt is generated by the relevant board.

All interrupt outputs are open-collector outputs and combined to form a single line. After the interrupt has occurred, all boards with synthesizer loops are polled via the selftest to determine whether the respective loop is okay.

When the loop that is out of lock has been found, an error message is indicated on the display. If a synthesizer interrupt occurs during the first $2^1/_2$ minutes after switching on of the instrument, no error message is output during this period; when an attempt is made to calibrate or start the selftest, the message "*Wait for Warmup*" appears. If there is still an interrupt after that, the respective error message is output.

For servicing purposes, the wait time can be switched off by entering service function 91 in the SERVICE MENU.
The following table contains synthesizer loops with the associated error messages.

Table 3-1

Source	Frequency range	Message
Synthesizer, 1st LO	9 kHz to 2750 MHz	1st LO unlock
Synthesizer, 1280 MHz	< 1000 MHz	2nd LO unlock
Synthesizer, 320 MHz	≥ 1000 MHz	2nd LO unlock
Synthesizer, Ref Loop with ext. ref. off	9 kHz to 2750 MHz	Ref Loop unlock
Synthesizer, Ref Loop with ext. ref. on	9 kHz to 2750 MHz	Check ext Ref
IF Analysis, LO IF Analysis	9 kHz to 2750 MHz	LO IF Analysis unlock
Tracking Generator	9 kHz to 2750 MHz	Track Gen unlock

The order given in the table corresponds to the order of the polls.
If no fault is determined during the poll, the measurement is continued without a message.

Monitoring the Supply Voltages

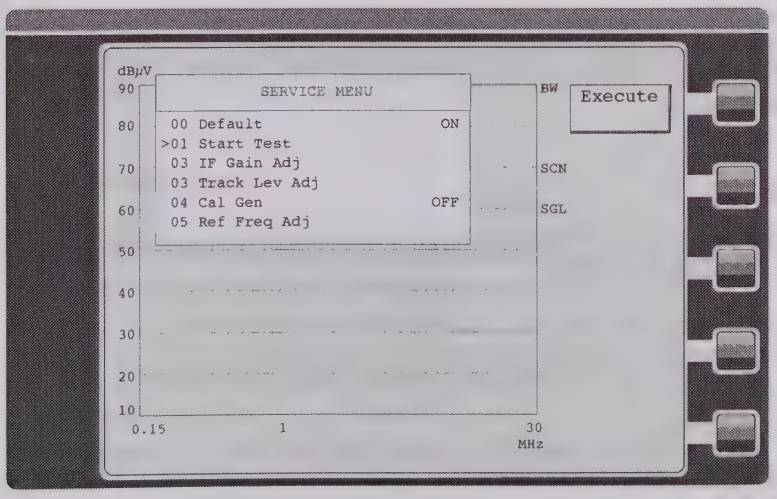
All internal supply voltages are roughly monitored in the power supply. A detailed description of the voltage monitoring functions is to be found in the service instructions for the rear panel. Proper functioning is indicated by the LED Supply OK on the rear panel of the instrument. If one of the supply voltages is out of tolerance, the instrument will automatically be switched off within 3 seconds.

The receiver can be switched on again by pressing the ON switch.

If the +5-V supply is shortly reduced, a reset of the controller is triggered. The receiver then behaves as if switched on anew.

User Selftest

- Press the Config key.
- Press the *Service Menu* softkey in the Config menu.
  A submenu appears which permits to select the following options:



By selecting the START TEST function in the selfttest menu, the selftest is triggered. The message *SELFTEST RUNNING* is displayed on the screen.

Testing the Controller Function

After starting the selftest or after a cold start of the instrument, the controller functions and the internal supply voltages are checked first. In the case of an error in one of the following function blocks on the CPU board:

- MAIN CPU (controller),
- OT PROM (memory for operating system),
- FLASH EPROM (Firmware program memory),
- IFPAS CONTROLLER (serial interface for board control) or
- CMOS RAM (non-volatile data memory)

it is possible that the instrument can no longer output a detailed error message. The instrument cannot be operated.

A fault in one of the function blocks

- DRAM (volatile data memory),
- MUART (multifunction device),
- INTERRUPT CONTROLLER or
- A/D converter

produces the message *ERR: CPU-BOARD*; in order to avoid faulty measurements, operation of the instrument remains disabled.

A fault in one of the function blocks

- REAL TIME CLOCK,
- IEC BUS CONTROLLER (IEC-BUS interface),
- RS232 CONTROLLER (serial interface for loading a new firmware)

is indicated by the error message

- ERROR:Time Clock,
- ERROR:IEC or
- ERROR:RS232.

The error message remains visible until it is deleted by calling up a menu. Since not all instrument functions access to all function units, operation with reduced capabilities may well be possible. The message *ERROR:CPU-BOARD* indicates that there is a faulty board. If no fault has been found, this is indicated by means of CPU-BOARD ok.

Testing the Supply Voltages

First, the internal supply voltages +5 V, +10 V, -10 V and +28 V are checked. Illegal deviations are indicated on the screen with the following messages:

- ERR: +5 V,
- ERR:+10 V,
- ERR: -10 V or
- ERR:+28 V;

The selftest is aborted, the message *Test aborted.* appears.

Synthesizertest

Proper functioning of the oscillators is a prerequisite for testing of the signal path. The board A120 (Synthesizer Unit) contains the VCO for control of the 1st mixer, a digital control loop, the second

conversion oscillator with control loop as well as the reference oscillator. Therefore, the synthesizer is checked next.

The board tests comprise testing of the control loop with various synthesizer divider factors, testing of the oscillator and amplifier operating points as well as of internal signal levels. A fault is indicated by means of *ERR: Synth*; the selftest is aborted, and the message *Test aborted* appears.

After successful termination of all the synthesizer tests, *Synth Boards ok* appears on the screen.

Testing the Signal Path

Subsequently, all RF, IF and weighting boards contained in the receiver are checked:

The board A110 (frontend) accommodates two calibration generators, which provide the test signals for testing of the signal-processing stages. The signal flow through the attenuator, the preselection filter, the preamplifier, the 1st mixer and the 1st 1354.7 or 74.7-MHz IF amplifier is checked by a level detector; besides, board-internal supply voltages, the operating points of the preamplifier and of the 1st IF amplifier and the tuning voltage of the tunable preselection filters are checked. If faults are found, they will be indicated by the message *ERR:Frontend*, *Test aborted* on the screen.

On board A130 (2ND MIXER), the DC operating points of the 2nd 1354.7-MHz IF amplifier and the 74.7-MHz IF amplifier are checked first; this is followed by testing of the output level of the 2nd LO amplifier (2nd LO Loop). Furthermore, the output level of the LO amplifier for controlling the 3rd mixer is checked. In the case of a fault, the message "*ERR:2nd Mixer*, Test aborted appears on the screen.

The selftest of board A170 (IF Selection Board) starts with testing of the operating points of the 10.7-MHz IF amplifiers. The signal level at the board input is polled by a level detector. The signal flow through the IF amplifiers and the main selection filters is checked by measuring the DC voltage level at the demodulator output. Besides, the digitally settable IF gain correction is checked. In the case of a fault, the message *ERR:IF Selection BD, Test aborted* appears on the screen.

Finally, board A180 (Detector Board) is tested. After testing of the board-internal supply voltages, a level detector checks the 10.7-MHz input level of the audio path. Then, the average (AV), peak (PK) and quasi-peak (QP) detector are checked. This is followed by testing of the log amplifier. Finally, the control circuit for the analog meter and the transducer correction are tested. If a faulty function is found, the message *ERR:Detector Board, Test aborted"* will appear on the screen.

If the options ESCS-B3 (IF Analysis) or ESCS-B4 (Tracking Generator) are fitted, these boards are tested.

Proper termination of the selftest is indicated by the message *SELFTEST COMPLETE, Instrument o.k.*. Then the ESCS returns to the normal operating status. The complete selftest takes about 120 seconds if it is terminated with "Instrument ok".

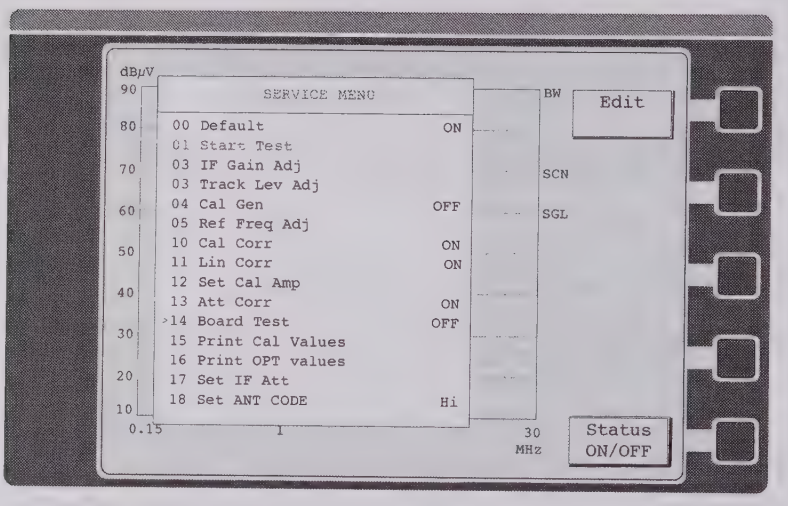
Service Selbsttest

Service function 91 can be used to call up the service selftest, which permits to perform a detailed investigation of particular boards or circuit parts. The service function cannot be seen in the service menu. It can only be activated by the respective numerical entry.

The inhibition of the calibration and the selftest (*01 Start Test)* that is effective for 2 $^1/_2$ minutes if there is a synthesizer interrupt is cancelled by entering the service function 91. This may result in inaccurate calibration correction values or selftest voltages if the reference oscillator has not yet reached its nominal frequency.

After the service function has been called up, a menu is displayed that is extended compared with the user selftest.

Menu for the service test:



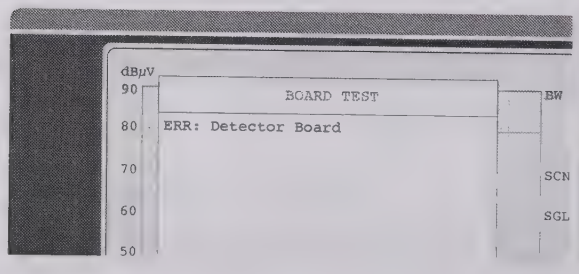
Complete Test (01 Start Test)

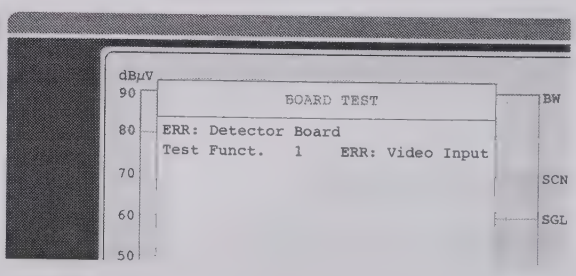
After calling up service function 91 the service selftest runs with *Start Test*. Except for the extended size of the CPU board test with detailed error hints (see service instructions for CPU-BOARD) the order and size of the test functions correspond to the user selftest described. The components tested in the signal path are to be obtained from the block diagram.

User and service selftest differ from each other as follows:

- The user selftest indicates the board that has caused the fault.
- The service selftest additionally indicates the faulty test function, and a detailed error message appears on the display:

  Example:





The test is aborted after the first fault has been found, and the display shows the message *Test aborted*. The fault can be further located with the aid of the table of test functions included in all board descriptions and the service function *14 BOARD TEST*.

Adjusting the Total Gain (02 IF Gain Adj),

The adjustment of the total gain and of the moving-coil meter is described in the section Board Replacement.

Output level of Tracking Generator (03 Track Lev Adj)

This function permits to vary the output level of the tracking generator in the range from -10 to -30 dBm. The default value is -17 dBm.

Operation:

- Select *Track Lev Adj.*
- Press the *Edit* softkey.
  The current value of the output level is displayed.
- Using the cursor key ← or → vary the level in 10-dB steps.
- Using the cursor key ↑ or ↓ vary the level in 1-dB steps.
- Leave the function again using ENTER.

Switching on the Calibration Generator (04 CAL Generator ON/OFF)

By calling up the service function *CAL Generator (ON)* the calibration generator can be switched on. The output level of the generator is 80 dBµV/MHz in the frequency range <30 MHz and 50 dBµV/MHz in the frequency range from 30 to 2750 MHz. Thus, a signal source is available that permits to perform investigations on the signal boards of the receiver. The pulse repetition frequencies 25 Hz and 100 Hz, which are only available in the frequency range < 30 MHz, are used e.g. for investigation of the quasi-peak detector.

Operation:

- Select service function *04 CAL Generator.*

Input	Frequency ≤30 MHz; low-freq. gen.	Frequency >30 MHz; high-freq. gen.
Enter from "OFF" position	25 Hz	-
Enter	100 Hz	-
Enter	100 kHz	100 kHz
Enter	OFF	OFF

If, with the 25-Hz or 100-Hz generator switched on, the frequency limit of 30 MHz is exceeded, the generator will be switched off.

Adjusting the Reference Oscillator (05 RefFreq Adj)

The function *RefFreq Adj* permits to adjust the reference oscillator with the aid of a D/A converter.

Operation:

- Select *RefFreq Adj.*
- Press the *Edit* softkey.
  The current D/A conversion value is displayed.
- Using the cursor key ←or → vary the value in steps of 10.
- Using the cursor key ↑ or ↓ vary the value in steps of 1.
- Use the ENTER key to store the value in the CMOS RAM or leave the function without storage by means of EXIT.

Switching off the Calibration Correction Values (10 CAL Corr)

With *CAL Corr OFF,* the correction values stored in the total calibration (except for the correction values for the IF analysis) are no longer taken into account. However, they remain stored and are activated again after switching off the service function. This is necessary e.g. for final adjustment of the receiver.

Operation:

- Select *CAL Corr.*
- Press the *Status ON/OFF* softkey.
- The function appears on the display with OFF.
- The calibration amplifier is set to 0 dB, irrespective of the receiver setting. Using the function *12 Set CAL Amp*, however, it can be set to any values.
- By pressing Status ON/OFF again, the correction values are considered again.

The service function is left by selecting another service function, by means of EXIT or by selecting another menu.

Switching off Linearity Correction Values (11 LIN Corr)

The service function *11 LIN Corr OFF* causes the linearity correction values to be not considered in the measurement. This is necessary for the adjustment of the demodulator or of the log amplifier.

Operation:

- Select *LIN Corr.*
- Press the *Status ON/OFF* softkey.
  The function appears on the screen with OFF.
- By pressing *Status ON/OFF* again, the correction values are taken into account again.

The service function is left by selecting another service function, by means of EXIT or by selecting another menu.

Setting the Calibration Amplifier (12 Set CAL Amp)

The calibration amplifier can be set to its nominal value of 0 dB ±6 dB in steps of 0.05 dB and 0.5 dB. To perform an adjustment, it must be set to a defined value.

Operation:

- Select the service function *12 Set CAL Amp.*
- Press the Edit softkey.
  The current gain value appears on the display.
- Using the cursor key ← or → vary the gain in 0.05-dB steps.
- Using the cursor key ↑ or ↓ vary the gain in 0.5-dB steps.
- Leave the function using ENTER.

Switching off Attenuator Correction (13 Att Corr)

The service function *13 Att Corr OFF* causes the correction values for the attenuator not to be considered.

Board Test (14 Board Test)

The service function *14 BOARD TEST* is used for specific investigation of individual circuit parts of a board. After calling up the function the desired board can be selected from the list displayed on the screen. A further submenu then permits to select between calling up of a particular test function (1 to n) or the complete board test. All service instructions for a board contain a list of the test functions, test settings, nominal values and the possible error message. If an error is found, it does not cause the test to be aborted as with the complete test. Following an error message, the *Cont* softkey permits to call up the next test function. EXIT permits to return to the menu of the boards.

Note: *As with the complete instrument test, proper functioning of all boards preconnected in the signal path is a prerequisite for appropriate error messages in the case of the board test as well. The boards have the following hierarchy of functions:*

1. *Rear Panel*
2. *CPU Board/Display Board*
3. *Synthesizer*
4. *Frontend*
5. *2nd Mixer*
6. *IF Selection Board*
7. *Detector Board*
8. *IF Analysis (if Option ESCS-B4 is fitted)*
9. *Tracking Generator (if Option ESCS-B5 is fitted)*

Thus, if there is eg a fault in the frontend, there may as well be error messages in the board test of the IF selection board or detector board. As soon as a test function has been entered, the associated board settings are made and the test input of the A/D converter switched on on the CPU board; the test voltage applied to the A/D converter is measured at an interval of 100 ms and indicated on the LEVEL display. (Format: 0.000 -1.999 V and 2.00 -5.00 V).

During the board selftest, all receiver parameters (frequency, RF Att, CALGen, etc.) can be varied.

Operation:

- Select *SERVICE MENU 14 Board Test.*
- Using the *Edit* key call up the list of boards.

Board	Number of test functions
Supply Test (in the synthesizer)	0...4
Synthesizer	0...10
Frontend	0...14
2nd Mixer	0...15
IF Selection Board	0...10
Detector Board	0...25
IF Analysis	0...16
Tracking Generator	0...12

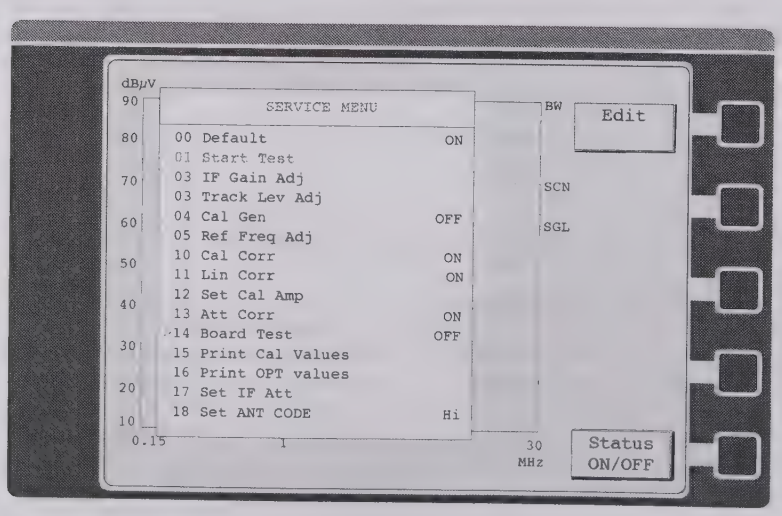
The board test is not available for the display board and the rear panel. The cursor keys ↑ and ↓ permit to select the desired board. The number of test functions depends on the selected board:

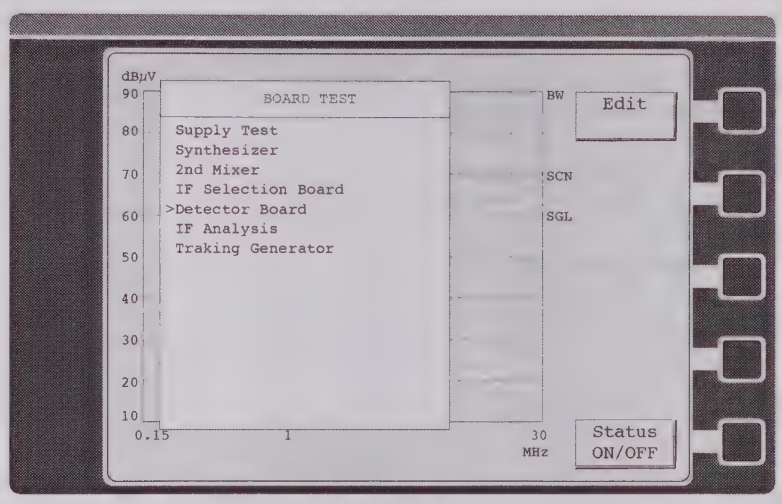
When the test function 0 is called up, the complete board test is performed. The message *Board Test running* is indicated on the display. If no error is found, the message *(board name) ok* appears.

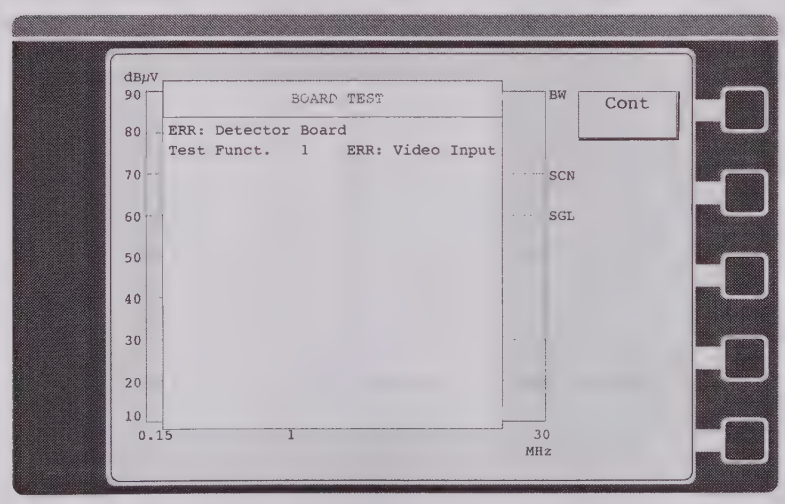
If a test voltage exceeds the tolerance, the number of the relevant test function is displayed with the associated error message. The test function remains switched on; the test voltage is indicated on the LEVEL display. The following test function can only be called up by pressing the Cont softkey. After all test functions have been run, the ESCS indicates *Test complete* in the case of a fault.

The *Status ON/OFF* softkey in the *SERVICE MENU* permits to switch off the operating mode *Board Test.* The *Board Test* is also terminated by starting procedures such as calibration, Scan, Start Test, Print, Plot as well as by RCL.

Example:




dBµV
90
80
70
60
50
40
30
20
10
BOARD TEST
Supply Test
Synthesizer
2nd Mixer
IF Selection Board
>Detector Board
IF Analysis
Traking Generator
BW
SCN
SGL
Edit
Status
ON/OFF
0.15
1
30
MHz


dBµV
90
80
70
60
50
40
30
20
10
BOARD TEST
ERR: Detector Board
Test Funct. 1 ERR: Video Input
BW
SCN
SGL
Cont
0.15
1
30
MHz

Printing out the Calibration Values (15 Print CAL values)

Print CAL values permits to output the correction values from the last total calibration on the printer. Fig. 3-3 shows a printout of the correction values by way of example.

```
CAL correction values for ESCS      Date of printing:  15. Oct 97
------------------------------      Date of last CAL:  15. Oct 97
FW Version 1.09

                                  corr.value/dB

abs. reference at 5.9MHz,    :        3.14
IF BW   9kHz,
IF ATT  40dB

gain offset, IF BW  200Hz    :       -0.83
gain offset, IF BW  120kHz   :        0.56
gain offset, IF BW    1MHz   :       -0.05

gain offset, IF ATT  30dB    :       -0.15
gain offset, IF ATT  20dB    :       -0.04
gain offset, IF ATT  10dB    :       -0.79
gain offset, IF ATT   0dB    :       -0.71
gain offset, IF ATT -10dB    :       -0.95

linearity, 60dB range
                  60dB       :       -0.43
                  50dB       :       -0.23
                  40dB       :       -0.08
                  30dB       :       -0.01
                  20dB       :        0.08
                  10dB       :       -0.26
                   0dB       :       -1.26

QP, Band A                   :       -0.16
QP, Band B                   :       -0.24
QP, Band C                   :        0.00

BW 200Hz , freq offset [Hz]  :          0

                                  Preamp OFF      Preamp ON
frequency           0.1 MHz  :       -2.30          -4.06
                    0.2 MHz  :       -1.56          -3.17
                    0.5 MHz  :       -1.80          -3.43
                    1.0 MHz  :       -1.74          -3.37
                    1.8 MHz  :       -1.59          -3.19
                    1.9 MHz  :       -1.54          -3.17
                    2.4 MHz  :       -0.96          -2.79
                    2.9 MHz  :       -0.90          -2.67
                    3.9 MHz  :       -0.69          -2.31
                    5.9 MHz  :        0.01          -1.62
                    7.9 MHz  :        1.69          -0.07
                    8.4 MHz  :        0.41          -1.37
                    8.9 MHz  :        0.35          -1.40
                    9.9 MHz  :        0.38          -1.36
                   14.9 MHz  :        0.49          -1.11
                   19.9 MHz  :        0.96          -0.53
                   24.9 MHz  :        1.46           0.14
                   25.4 MHz  :        1.16          -0.41
                   25.9 MHz  :        1.24          -0.34
                   27.9 MHz  :        1.38          -0.27
                   29.4 MHz  :        1.56          -0.09
                   29.9 MHz  :        1.47          -0.18
                   30.4 MHz  :       -1.07          -4.29
```

Fig. 3-3 Printout of calibration correction values (example)

30.9 MHz	:	-1.22	-4.44
40.9 MHz	:	-1.04	-4.28
50.9 MHz	:	-0.74	-4.02
60.9 MHz	:	-0.46	-3.80
70.9 MHz	:	-0.30	-3.67
79.9 MHz	:	-0.30	-3.71
80.4 MHz	:	-0.79	-4.07
90.9 MHz	:	-0.72	-4.04
100.9 MHz	:	-0.71	-4.05
110.9 MHz	:	-0.75	-4.08
120.9 MHz	:	-0.76	-4.07
130.9 MHz	:	-0.82	-4.10
140.9 MHz	:	-0.80	-4.10
150.9 MHz	:	-0.71	-4.06
160.9 MHz	:	-0.65	-4.03
170.9 MHz	:	-0.59	-4.02
180.9 MHz	:	-0.57	-3.98
190.9 MHz	:	-0.44	-3.93
199.9 MHz	:	-0.23	-3.32
200.4 MHz	:	-0.51	-3.82
210.9 MHz	:	-0.43	-3.76
220.9 MHz	:	-0.40	-3.75
230.9 MHz	:	-0.33	-3.68
240.9 MHz	:	-0.25	-3.54
250.9 MHz	:	-0.27	-3.51
260.9 MHz	:	-0.29	-3.50
270.9 MHz	:	-0.27	-3.46
280.9 MHz	:	-0.23	-3.41
290.9 MHz	:	-0.16	-3.25
300.9 MHz	:	-0.15	-3.24
310.9 MHz	:	-0.07	-3.07
320.9 MHz	:	0.04	-2.94
330.9 MHz	:	0.06	-2.92
340.9 MHz	:	0.06	-2.94
350.9 MHz	:	0.11	-2.87
360.9 MHz	:	0.12	-2.82
370.9 MHz	:	0.14	-2.78
380.9 MHz	:	0.12	-2.84
390.9 MHz	:	0.11	-2.81
400.9 MHz	:	0.06	-2.80
410.9 MHz	:	0.10	-2.76
420.9 MHz	:	0.09	-2.72
430.9 MHz	:	0.08	-2.70
440.9 MHz	:	0.07	-2.74
450.9 MHz	:	0.15	-2.68
460.9 MHz	:	0.19	-2.63
470.9 MHz	:	0.25	-2.59
480.9 MHz	:	0.30	-2.67
490.9 MHz	:	0.36	-2.76
499.9 MHz	:	0.38	-2.74
500.4 MHz	:	-1.11	-4.12
510.9 MHz	:	-1.17	-4.15
520.9 MHz	:	-1.25	-4.15
530.9 MHz	:	-1.31	-4.14
540.9 MHz	:	-1.33	-4.13
550.9 MHz	:	-1.38	-4.07
560.9 MHz	:	-1.41	-3.89
570.9 MHz	:	-1.40	-3.77
580.9 MHz	:	-1.40	-3.68
590.9 MHz	:	-1.41	-3.62

Fig. 3-3 continued

96 :	82
97 :	83
98 :	84
99 :	85
100 :	86
101 :	87
102 :	88
103 :	89
104 :	90
105 :	91
106 :	93
107 :	94
108 :	95
109 :	96
110 :	97
111 :	98
112 :	99
113 :	100
114 :	101
115 :	103
116 :	104
117 :	105
118 :	107
119 :	108
120 :	110
121 :	111
122 :	112
123 :	114
124 :	115
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132 :	124
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136 :	129
137 :	130
138 :	131
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153 :	144
154 :	145
155 :	146

Fig. 3-3 continued

156 :	147
157 :	148
158 :	149
159 :	150
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162 :	154
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165 :	157
166 :	158
167 :	159
168 :	160
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209 :	209
210 :	210
211 :	211
212 :	211
213 :	212
214 :	213
215 :	214

Fig. 3-3 continued

Operation:

- Select service function *15 Print CAL values.*
- Press *Execute* softkey.
  The calibration correction values are output to the connected printer. After the output has been finished, the service function is automatically switched off again.

Printing out the OTP Values(Print OTP Values)

This service function permits to print out the attenuator correction values individually recorded for each frontend for the attenuations 5 to 60 dB and the calibration generator correction values which are stored in 2 non-volatile OTPROMs.

```
OTP correction values for ESCS
------------------------------
FW Version 1.09

day  :  13
month:  2
year :  97
serie:  2
check:  -5825

ref val / 5.9MHz:  1.04
```

	0dB	5dB	10dB	15dB	20dB	25dB	30dB
0.1 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
0.2 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
0.5 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
1.0 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
1.8 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
1.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
2.4 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
2.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
3.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
5.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
7.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
8.4 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
8.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
9.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
14.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
19.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
24.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
25.4 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
25.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
27.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
29.4 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
29.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
30.4 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
30.9 MHz:	-0.18	0.00	0.00	-0.41	-0.41	-0.64	-0.63
40.9 MHz:	-0.20	0.00	0.00	-0.40	-0.40	-0.63	-0.62
50.9 MHz:	-0.22	0.01	0.00	-0.40	-0.40	-0.61	-0.60
60.9 MHz:	-0.24	0.01	0.00	-0.39	-0.39	-0.60	-0.59
70.9 MHz:	-0.25	0.01	0.00	-0.38	-0.38	-0.58	-0.58
79.9 MHz:	-0.27	0.01	0.00	-0.37	-0.37	-0.57	-0.57
80.4 MHz:	-0.27	0.01	0.00	-0.37	-0.37	-0.57	-0.57
90.9 MHz:	-0.29	0.02	0.00	-0.37	-0.37	-0.55	-0.55
100.9 MHz:	-0.31	0.02	0.00	-0.36	-0.36	-0.54	-0.54
110.9 MHz:	-0.32	0.02	0.00	-0.35	-0.35	-0.53	-0.53
120.9 MHz:	-0.32	0.02	0.00	-0.34	-0.33	-0.52	-0.51
130.9 MHz:	-0.33	0.01	0.00	-0.33	-0.32	-0.51	-0.50
140.9 MHz:	-0.33	0.01	0.00	-0.32	-0.30	-0.50	-0.49
150.9 MHz:	-0.34	0.01	0.00	-0.31	-0.29	-0.48	-0.47
160.9 MHz:	-0.34	0.01	0.00	-0.30	-0.28	-0.47	-0.46
170.9 MHz:	-0.35	0.01	0.00	-0.29	-0.26	-0.46	-0.45
180.9 MHz:	-0.35	0.00	0.00	-0.28	-0.25	-0.45	-0.43
190.9 MHz:	-0.36	0.00	0.00	-0.27	-0.23	-0.44	-0.42
199.9 MHz:	-0.36	0.00	0.00	-0.26	-0.22	-0.43	-0.41
200.4 MHz:	-0.36	0.00	0.00	-0.26	-0.22	-0.43	-0.41
210.9 MHz:	-0.37	0.00	0.00	-0.25	-0.21	-0.42	-0.39
220.9 MHz:	-0.38	0.00	0.00	-0.24	-0.19	-0.41	-0.38
230.9 MHz:	-0.38	-0.01	0.00	-0.23	-0.18	-0.40	-0.36

Fig. 3-4 Printout of OTP correction values

240.9 MHz:	-0.39	-0.01	0.00	-0.22	-0.16	-0.39	-0.35
250.9 MHz:	-0.39	-0.01	0.00	-0.21	-0.15	-0.37	-0.34
260.9 MHz:	-0.40	-0.01	0.00	-0.20	-0.14	-0.36	-0.32
270.9 MHz:	-0.40	-0.01	0.00	-0.19	-0.12	-0.35	-0.31
280.9 MHz:	-0.41	-0.02	0.00	-0.18	-0.11	-0.34	-0.30
290.9 MHz:	-0.41	-0.02	0.00	-0.17	-0.09	-0.33	-0.28
300.9 MHz:	-0.42	-0.02	0.00	-0.16	-0.08	-0.32	-0.27
310.9 MHz:	-0.47	-0.02	0.00	-0.18	-0.10	-0.34	-0.29
320.9 MHz:	-0.51	-0.02	0.00	-0.19	-0.12	-0.35	-0.30
330.9 MHz:	-0.56	-0.02	0.00	-0.21	-0.14	-0.37	-0.32
340.9 MHz:	-0.61	-0.01	0.00	-0.22	-0.15	-0.39	-0.34
350.9 MHz:	-0.66	-0.01	0.00	-0.24	-0.17	-0.41	-0.36
360.9 MHz:	-0.70	-0.01	0.00	-0.25	-0.19	-0.42	-0.37
370.9 MHz:	-0.75	-0.01	0.00	-0.27	-0.21	-0.44	-0.39
380.9 MHz:	-0.79	-0.02	0.00	-0.28	-0.21	-0.45	-0.40
390.9 MHz:	-0.82	-0.04	0.00	-0.29	-0.22	-0.46	-0.40
400.9 MHz:	-0.86	-0.05	0.00	-0.30	-0.23	-0.47	-0.41
410.9 MHz:	-0.89	-0.06	0.00	-0.31	-0.23	-0.48	-0.42
420.9 MHz:	-0.90	-0.05	0.00	-0.30	-0.23	-0.45	-0.40
430.9 MHz:	-0.90	-0.04	0.00	-0.29	-0.22	-0.43	-0.37
440.9 MHz:	-0.91	-0.03	0.00	-0.28	-0.22	-0.40	-0.35
450.9 MHz:	-0.92	-0.04	0.00	-0.28	-0.23	-0.38	-0.34
460.9 MHz:	-0.93	-0.05	0.00	-0.28	-0.24	-0.36	-0.32
470.9 MHz:	-0.94	-0.06	0.00	-0.28	-0.25	-0.34	-0.31
480.9 MHz:	-0.86	-0.08	0.00	-0.21	-0.19	-0.27	-0.23
490.9 MHz:	-0.78	-0.09	0.00	-0.14	-0.13	-0.19	-0.15
499.9 MHz:	-0.71	-0.11	0.00	-0.07	-0.08	-0.12	-0.07
500.4 MHz:	-0.71	-0.11	0.00	-0.07	-0.08	-0.12	-0.07
510.9 MHz:	-0.67	-0.10	0.00	-0.07	-0.09	-0.08	-0.03
520.9 MHz:	-0.64	-0.08	0.00	-0.06	-0.10	-0.04	0.01
530.9 MHz:	-0.60	-0.07	0.00	-0.06	-0.10	-0.01	0.05
540.9 MHz:	-0.57	-0.06	0.00	-0.06	-0.11	0.03	0.09
550.9 MHz:	-0.61	-0.04	0.00	-0.12	-0.18	0.01	0.06
560.9 MHz:	-0.65	-0.02	0.00	-0.18	-0.25	-0.02	0.04
570.9 MHz:	-0.70	0.01	0.00	-0.23	-0.33	-0.04	0.01
580.9 MHz:	-0.74	0.03	0.00	-0.29	-0.40	-0.07	-0.01
590.9 MHz:	-0.78	0.05	0.00	-0.35	-0.47	-0.09	-0.04
600.9 MHz:	-0.80	0.03	0.00	-0.35	-0.47	-0.07	-0.02
610.9 MHz:	-0.82	0.02	0.00	-0.35	-0.48	-0.06	0.00
620.9 MHz:	-0.83	0.00	0.00	-0.35	-0.48	-0.04	0.02
630.9 MHz:	-0.85	-0.01	0.00	-0.35	-0.49	-0.02	0.04
640.9 MHz:	-0.87	-0.03	0.00	-0.35	-0.49	-0.01	0.06
650.9 MHz:	-0.89	-0.04	0.00	-0.34	-0.50	0.01	0.07
660.9 MHz:	-0.91	-0.06	0.00	-0.34	-0.50	0.02	0.09
670.9 MHz:	-0.93	-0.07	0.00	-0.34	-0.51	0.04	0.11
680.9 MHz:	-0.94	-0.09	0.00	-0.34	-0.51	0.06	0.13
690.9 MHz:	-0.96	-0.10	0.00	-0.34	-0.52	0.07	0.15
700.9 MHz:	-0.98	-0.12	0.00	-0.34	-0.52	0.09	0.17
710.9 MHz:	-0.98	-0.12	0.00	-0.35	-0.53	0.10	0.18
720.9 MHz:	-0.99	-0.12	0.00	-0.36	-0.53	0.12	0.19
730.9 MHz:	-0.99	-0.12	0.00	-0.37	-0.54	0.13	0.20
740.9 MHz:	-1.00	-0.12	0.00	-0.39	-0.54	0.14	0.22
750.9 MHz:	-1.00	-0.12	0.00	-0.40	-0.55	0.16	0.23
760.9 MHz:	-1.00	-0.12	0.00	-0.41	-0.56	0.17	0.24
770.9 MHz:	-1.01	-0.12	0.00	-0.42	-0.56	0.18	0.25
780.9 MHz:	-1.01	-0.12	0.00	-0.43	-0.57	0.19	0.26
790.9 MHz:	-1.02	-0.12	0.00	-0.44	-0.57	0.21	0.27
800.9 MHz:	-1.02	-0.12	0.00	-0.45	-0.58	0.22	0.28
810.9 MHz:	-1.02	-0.12	0.00	-0.47	-0.59	0.23	0.30
820.9 MHz:	-1.03	-0.12	0.00	-0.48	-0.59	0.25	0.31

Fig. 3-4 continued

830.9 MHz:	-1.03	-0.12	0.00	-0.49	-0.60	0.26	0.32
840.9 MHz:	-1.04	-0.12	0.00	-0.50	-0.60	0.27	0.33
850.9 MHz:	-1.04	-0.12	0.00	-0.51	-0.61	0.28	0.34
860.9 MHz:	-1.04	-0.12	0.00	-0.52	-0.62	0.30	0.35
870.9 MHz:	-1.05	-0.12	0.00	-0.54	-0.62	0.31	0.37
880.9 MHz:	-1.05	-0.12	0.00	-0.55	-0.63	0.32	0.38
890.9 MHz:	-1.06	-0.12	0.00	-0.56	-0.63	0.34	0.39
900.9 MHz:	-1.06	-0.12	0.00	-0.57	-0.64	0.35	0.40
910.9 MHz:	-1.06	-0.12	0.00	-0.55	-0.60	0.38	0.44
920.9 MHz:	-1.06	-0.13	0.00	-0.53	-0.56	0.41	0.48
930.9 MHz:	-1.06	-0.13	0.00	-0.51	-0.52	0.44	0.53
940.9 MHz:	-1.06	-0.14	0.00	-0.49	-0.48	0.47	0.57
950.9 MHz:	-1.06	-0.14	0.00	-0.47	-0.44	0.50	0.61
960.9 MHz:	-1.07	-0.17	0.00	-0.47	-0.42	0.52	0.64
970.9 MHz:	-1.08	-0.19	0.00	-0.46	-0.40	0.54	0.67
980.9 MHz:	-1.07	-0.18	0.00	-0.45	-0.36	0.58	0.72
990.9 MHz:	-1.05	-0.17	0.00	-0.43	-0.32	0.62	0.77
999.9 MHz:	-1.04	-0.16	0.00	-0.42	-0.28	0.65	0.81
1000.4 MHz:	-1.16	-0.30	0.00	-0.46	-0.30	0.49	0.66
1050.9 MHz:	-1.13	-0.18	0.00	-0.32	-0.06	0.68	0.94
1100.9 MHz:	-1.16	-0.23	0.00	-0.41	0.03	0.76	1.09
1150.9 MHz:	-1.28	-0.32	0.00	-0.34	0.19	0.86	1.19
1200.9 MHz:	-1.37	-0.38	0.00	-0.25	0.42	0.92	1.29
1250.9 MHz:	-1.49	-0.39	0.00	-0.16	0.53	1.03	1.36
1300.9 MHz:	-1.62	-0.34	0.00	-0.11	0.58	1.11	1.42
1350.9 MHz:	-1.80	-0.27	0.00	-0.05	0.56	1.12	1.44
1400.9 MHz:	-1.98	-0.20	0.00	0.01	0.53	1.14	1.45
1450.9 MHz:	-1.76	-0.33	0.00	-0.02	0.34	1.36	1.68
1500.9 MHz:	-1.54	-0.45	0.00	-0.06	0.14	1.59	1.91
1550.9 MHz:	-1.50	-0.29	0.00	-0.06	-0.05	1.65	1.93
1600.9 MHz:	-1.46	-0.12	0.00	-0.06	-0.23	1.71	1.95
1650.9 MHz:	-1.46	-0.11	0.00	-0.09	-0.36	1.78	1.95
1700.9 MHz:	-1.47	-0.11	0.00	-0.13	-0.48	1.85	1.94
1750.9 MHz:	-1.44	0.03	0.00	-0.10	-0.47	2.01	2.05
1800.9 MHz:	-1.52	0.02	0.00	-0.24	-0.55	1.87	1.96
1850.9 MHz:	-1.69	-0.12	0.00	-0.36	-0.60	1.77	1.84
1900.9 MHz:	-1.67	-0.28	0.00	-0.34	-0.43	1.76	1.89
1959.9 MHz:	-1.38	-0.10	0.00	-0.10	-0.10	1.90	2.00
1960.4 MHz:	-1.37	-0.06	0.00	-0.11	-0.10	1.86	1.98
2000.9 MHz:	-1.49	-0.04	0.00	-0.14	0.05	1.74	1.92
2050.9 MHz:	-1.48	0.04	0.00	-0.06	0.17	1.69	1.78
2100.9 MHz:	-1.80	-0.09	0.00	-0.28	0.16	1.37	1.52
2150.9 MHz:	-1.99	-0.25	0.00	-0.48	0.05	1.08	1.26
2200.9 MHz:	-1.97	-0.31	0.00	-0.52	0.03	1.01	1.30
2250.9 MHz:	-1.90	-0.33	0.00	-0.44	0.12	1.10	1.47
2300.9 MHz:	-1.84	-0.22	0.00	-0.32	0.16	1.17	1.55
2350.9 MHz:	-1.97	-0.23	0.00	-0.31	0.09	1.06	1.34
2400.9 MHz:	-2.07	-0.20	0.00	-0.31	0.05	0.89	1.10
2450.9 MHz:	-2.01	-0.14	0.00	-0.26	0.01	0.87	0.97
2499.9 MHz:	-2.31	-0.04	0.00	-0.35	-0.14	0.50	0.51
2550.9 MHz:	-2.38	-0.02	0.00	-0.40	-0.09	0.22	0.33
2600.9 MHz:	-2.23	0.21	0.00	-0.16	0.02	0.38	0.31
2650.9 MHz:	-2.24	0.03	0.00	-0.19	0.14	0.25	0.32
2700.9 MHz:	-2.22	-0.13	0.00	-0.13	0.05	0.30	0.25
2749.9 MHz:	-2.38	-0.17	0.00	-0.26	-0.11	0.07	0.11

	35dB	40dB	45dB	50dB	55dB	60dB	Gen
0.1 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-1.10
0.2 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.60
0.5 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.39

Fig. 3-4 continued

410.9 MHz:	-0.69	-0.61	-1.18	-1.13	-1.36	-1.29	-1.49
420.9 MHz:	-0.67	-0.60	-1.15	-1.10	-1.34	-1.27	-1.60
430.9 MHz:	-0.65	-0.59	-1.13	-1.08	-1.32	-1.25	-1.70
440.9 MHz:	-0.63	-0.58	-1.10	-1.05	-1.30	-1.23	-1.85
450.9 MHz:	-0.62	-0.58	-1.08	-1.03	-1.28	-1.24	-1.92
460.9 MHz:	-0.62	-0.59	-1.05	-1.01	-1.27	-1.24	-2.02
470.9 MHz:	-0.61	-0.59	-1.03	-0.99	-1.25	-1.25	-2.13
480.9 MHz:	-0.54	-0.53	-0.89	-0.85	-1.12	-1.12	-2.24
490.9 MHz:	-0.47	-0.47	-0.75	-0.71	-0.99	-0.99	-2.36
499.9 MHz:	-0.40	-0.41	-0.62	-0.58	-0.87	-0.87	-2.45
500.4 MHz:	-0.40	-0.41	-0.61	-0.57	-0.86	-0.86	-2.48
510.9 MHz:	-0.37	-0.39	-0.54	-0.50	-0.80	-0.81	-2.59
520.9 MHz:	-0.33	-0.37	-0.48	-0.44	-0.75	-0.77	-2.69
530.9 MHz:	-0.30	-0.35	-0.41	-0.37	-0.69	-0.72	-2.77
540.9 MHz:	-0.27	-0.33	-0.35	-0.31	-0.64	-0.68	-2.85
550.9 MHz:	-0.30	-0.37	-0.36	-0.33	-0.66	-0.72	-2.95
560.9 MHz:	-0.33	-0.42	-0.38	-0.34	-0.68	-0.75	-3.03
570.9 MHz:	-0.37	-0.46	-0.39	-0.36	-0.71	-0.79	-3.10
580.9 MHz:	-0.40	-0.51	-0.41	-0.37	-0.73	-0.82	-3.19
590.9 MHz:	-0.43	-0.55	-0.42	-0.39	-0.75	-0.86	-3.31
600.9 MHz:	-0.42	-0.54	-0.42	-0.39	-0.75	-0.87	-3.41
610.9 MHz:	-0.40	-0.53	-0.42	-0.39	-0.76	-0.88	-3.54
620.9 MHz:	-0.39	-0.53	-0.42	-0.39	-0.76	-0.89	-3.65
630.9 MHz:	-0.38	-0.52	-0.42	-0.39	-0.77	-0.90	-3.74
640.9 MHz:	-0.36	-0.51	-0.42	-0.39	-0.77	-0.91	-3.86
650.9 MHz:	-0.35	-0.50	-0.43	-0.39	-0.78	-0.92	-3.97
660.9 MHz:	-0.33	-0.49	-0.43	-0.39	-0.78	-0.93	-4.09
670.9 MHz:	-0.32	-0.48	-0.43	-0.39	-0.79	-0.94	-4.20
680.9 MHz:	-0.31	-0.48	-0.43	-0.39	-0.79	-0.95	-4.30
690.9 MHz:	-0.29	-0.47	-0.43	-0.39	-0.80	-0.96	-4.42
700.9 MHz:	-0.28	-0.46	-0.43	-0.39	-0.80	-0.97	-4.49
710.9 MHz:	-0.27	-0.45	-0.42	-0.38	-0.79	-0.96	-4.53
720.9 MHz:	-0.27	-0.44	-0.40	-0.36	-0.79	-0.95	-4.54
730.9 MHz:	-0.26	-0.43	-0.39	-0.35	-0.78	-0.93	-4.52
740.9 MHz:	-0.26	-0.41	-0.37	-0.33	-0.77	-0.92	-4.54
750.9 MHz:	-0.25	-0.40	-0.36	-0.32	-0.76	-0.91	-4.55
760.9 MHz:	-0.24	-0.39	-0.35	-0.31	-0.76	-0.90	-4.58
770.9 MHz:	-0.24	-0.38	-0.33	-0.29	-0.75	-0.88	-4.63
780.9 MHz:	-0.23	-0.37	-0.32	-0.28	-0.74	-0.87	-4.73
790.9 MHz:	-0.23	-0.36	-0.30	-0.26	-0.73	-0.86	-4.79
800.9 MHz:	-0.22	-0.34	-0.29	-0.25	-0.72	-0.85	-4.90
810.9 MHz:	-0.21	-0.33	-0.28	-0.24	-0.72	-0.83	-4.95
820.9 MHz:	-0.21	-0.32	-0.26	-0.22	-0.71	-0.82	-5.04
830.9 MHz:	-0.20	-0.31	-0.25	-0.21	-0.70	-0.81	-5.14
840.9 MHz:	-0.20	-0.30	-0.23	-0.19	-0.70	-0.79	-5.25
850.9 MHz:	-0.19	-0.29	-0.22	-0.18	-0.69	-0.78	-5.34
860.9 MHz:	-0.18	-0.28	-0.21	-0.17	-0.68	-0.77	-5.45
870.9 MHz:	-0.18	-0.26	-0.19	-0.15	-0.67	-0.76	-5.56
880.9 MHz:	-0.17	-0.25	-0.18	-0.14	-0.67	-0.74	-5.68
890.9 MHz:	-0.17	-0.24	-0.16	-0.12	-0.66	-0.73	-5.77
900.9 MHz:	-0.16	-0.23	-0.15	-0.11	-0.65	-0.72	-5.83
910.9 MHz:	-0.13	-0.18	-0.11	-0.06	-0.60	-0.65	-5.91
920.9 MHz:	-0.10	-0.13	-0.06	0.00	-0.55	-0.58	-6.00
930.9 MHz:	-0.06	-0.07	-0.02	0.05	-0.49	-0.52	-6.11
940.9 MHz:	-0.03	-0.02	0.03	0.11	-0.44	-0.45	-6.17
950.9 MHz:	0.00	0.03	0.07	0.16	-0.39	-0.38	-6.28
960.9 MHz:	0.03	0.08	0.09	0.19	-0.37	-0.32	-6.37
970.9 MHz:	0.06	0.13	0.12	0.23	-0.34	-0.26	-6.45
980.9 MHz:	0.11	0.21	0.18	0.31	-0.27	-0.16	-6.54
990.9 MHz:	0.16	0.29	0.24	0.39	-0.20	-0.07	-6.59

Fig. 3-4 continuedFig.

1.0 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.27
1.8 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.18
1.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.22
2.4 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.12
2.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.13
3.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.06
5.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.00
7.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.00
8.4 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	-0.04
8.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.01
9.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.05
14.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.06
19.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.16
24.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.14
25.4 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.20
25.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.13
27.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.08
29.4 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.28
29.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.16
30.4 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.00
30.9 MHz:	-1.04	-1.05	-1.43	-1.44	-1.81	-1.83	0.01
40.9 MHz:	-1.03	-1.03	-1.42	-1.43	-1.80	-1.82	0.17
50.9 MHz:	-1.01	-1.02	-1.42	-1.43	-1.80	-1.81	0.21
60.9 MHz:	-1.00	-1.00	-1.41	-1.42	-1.79	-1.80	0.25
70.9 MHz:	-0.99	-0.99	-1.41	-1.42	-1.78	-1.80	0.22
79.9 MHz:	-0.98	-0.97	-1.40	-1.41	-1.77	-1.79	0.17
80.4 MHz:	-0.98	-0.97	-1.40	-1.41	-1.77	-1.79	0.21
90.9 MHz:	-0.96	-0.96	-1.40	-1.41	-1.77	-1.78	0.16
100.9 MHz:	-0.95	-0.94	-1.39	-1.40	-1.76	-1.77	0.17
110.9 MHz:	-0.93	-0.92	-1.38	-1.39	-1.74	-1.75	0.11
120.9 MHz:	-0.91	-0.89	-1.37	-1.38	-1.73	-1.73	0.08
130.9 MHz:	-0.89	-0.87	-1.36	-1.36	-1.71	-1.71	-0.01
140.9 MHz:	-0.88	-0.85	-1.35	-1.35	-1.69	-1.68	-0.03
150.9 MHz:	-0.86	-0.83	-1.34	-1.34	-1.68	-1.66	-0.04
160.9 MHz:	-0.84	-0.80	-1.33	-1.33	-1.66	-1.64	-0.08
170.9 MHz:	-0.82	-0.78	-1.32	-1.32	-1.64	-1.62	-0.12
180.9 MHz:	-0.80	-0.76	-1.31	-1.30	-1.62	-1.60	-0.15
190.9 MHz:	-0.78	-0.74	-1.30	-1.29	-1.61	-1.58	-0.17
199.9 MHz:	-0.77	-0.72	-1.29	-1.28	-1.59	-1.56	-0.20
200.4 MHz:	-0.77	-0.72	-1.29	-1.28	-1.59	-1.56	-0.23
210.9 MHz:	-0.75	-0.69	-1.28	-1.27	-1.57	-1.53	-0.28
220.9 MHz:	-0.73	-0.67	-1.27	-1.26	-1.56	-1.51	-0.31
230.9 MHz:	-0.71	-0.65	-1.26	-1.24	-1.54	-1.49	-0.35
240.9 MHz:	-0.69	-0.62	-1.25	-1.23	-1.52	-1.47	-0.37
250.9 MHz:	-0.67	-0.60	-1.24	-1.22	-1.51	-1.45	-0.43
260.9 MHz:	-0.65	-0.58	-1.23	-1.21	-1.49	-1.43	-0.48
270.9 MHz:	-0.64	-0.56	-1.22	-1.20	-1.47	-1.40	-0.55
280.9 MHz:	-0.62	-0.53	-1.21	-1.18	-1.45	-1.38	-0.62
290.9 MHz:	-0.60	-0.51	-1.20	-1.17	-1.44	-1.36	-0.65
300.9 MHz:	-0.58	-0.49	-1.19	-1.16	-1.42	-1.34	-0.73
310.9 MHz:	-0.59	-0.50	-1.19	-1.16	-1.42	-1.34	-0.79
320.9 MHz:	-0.61	-0.51	-1.20	-1.16	-1.41	-1.33	-0.82
330.9 MHz:	-0.62	-0.52	-1.20	-1.16	-1.41	-1.33	-0.90
340.9 MHz:	-0.63	-0.54	-1.21	-1.17	-1.40	-1.32	-0.97
350.9 MHz:	-0.64	-0.55	-1.21	-1.17	-1.40	-1.32	-1.02
360.9 MHz:	-0.66	-0.56	-1.22	-1.17	-1.39	-1.31	-1.10
370.9 MHz:	-0.67	-0.57	-1.22	-1.17	-1.39	-1.31	-1.18
380.9 MHz:	-0.68	-0.58	-1.21	-1.16	-1.38	-1.31	-1.25
390.9 MHz:	-0.68	-0.59	-1.20	-1.15	-1.38	-1.30	-1.32
400.9 MHz:	-0.69	-0.60	-1.19	-1.14	-1.37	-1.30	-1.41

Fig. 3-4 continued

999.9 MHz:	0.20	0.36	0.29	0.46	-0.13	0.02	-6.67
1000.4 MHz:	0.04	0.20	-0.12	0.05	-0.54	-0.40	-6.78
1050.9 MHz:	0.35	0.65	0.25	0.50	-0.04	0.24	-7.14
1100.9 MHz:	0.58	1.01	0.44	0.77	0.27	0.71	-7.43
1150.9 MHz:	0.81	1.33	0.60	0.92	0.55	1.08	-7.92
1200.9 MHz:	0.97	1.62	0.70	1.05	0.75	1.41	-8.43
1250.9 MHz:	1.13	1.82	0.83	1.14	0.95	1.65	-8.87
1300.9 MHz:	1.25	1.94	0.94	1.24	1.08	1.78	-8.94
1350.9 MHz:	1.28	1.89	0.98	1.27	1.14	1.74	-8.79
1400.9 MHz:	1.30	1.84	1.01	1.29	1.19	1.71	-8.64
1450.9 MHz:	1.53	1.90	1.22	1.52	1.42	1.76	-8.52
1500.9 MHz:	1.77	1.96	1.43	1.75	1.64	1.81	-8.33
1550.9 MHz:	1.78	1.80	1.52	1.80	1.68	1.70	-8.41
1600.9 MHz:	1.80	1.64	1.61	1.85	1.72	1.59	-8.58
1650.9 MHz:	1.76	1.50	1.71	1.86	1.70	1.46	-8.92
1700.9 MHz:	1.72	1.36	1.81	1.86	1.67	1.33	-9.19
1750.9 MHz:	1.77	1.40	1.86	1.91	1.64	1.27	-9.43
1800.9 MHz:	1.59	1.27	1.65	1.68	1.36	1.07	-9.55
1850.9 MHz:	1.47	1.21	1.47	1.54	1.17	0.93	-9.45
1900.9 MHz:	1.48	1.36	1.43	1.55	1.14	1.03	-9.12
1959.9 MHz:	1.66	1.67	1.54	1.63	1.30	1.31	-8.52
1960.4 MHz:	1.65	1.62	1.60	1.68	1.36	1.40	-8.62
2000.9 MHz:	1.52	1.73	1.43	1.58	1.19	1.37	-8.30
2050.9 MHz:	1.51	1.75	1.28	1.33	1.09	1.35	-7.95
2100.9 MHz:	1.14	1.61	0.86	0.99	0.65	1.09	-7.93
2150.9 MHz:	0.87	1.39	0.57	0.73	0.35	0.86	-8.01
2200.9 MHz:	0.80	1.38	0.48	0.71	0.29	0.86	-7.98
2250.9 MHz:	0.90	1.47	0.50	0.84	0.28	0.87	-8.20
2300.9 MHz:	0.96	1.45	0.46	0.78	0.23	0.73	-8.27
2350.9 MHz:	0.80	1.22	0.18	0.46	-0.07	0.34	-8.09
2400.9 MHz:	0.64	0.96	-0.14	0.05	-0.43	-0.06	-8.42
2450.9 MHz:	0.57	0.87	-0.28	-0.18	-0.60	-0.27	-8.53
2499.9 MHz:	0.27	0.45	-0.68	-0.67	-1.00	-0.71	-8.82
2550.9 MHz:	-0.03	0.29	-1.03	-0.98	-1.34	-0.96	-9.22
2600.9 MHz:	0.13	0.29	-0.97	-1.03	-1.32	-1.04	-9.41
2650.9 MHz:	-0.04	0.27	-1.18	-1.09	-1.48	-1.10	-9.76
2700.9 MHz:	-0.05	0.18	-1.30	-1.25	-1.55	-1.33	-9.92
2749.9 MHz:	-0.20	-0.01	-1.54	-1.49	-1.83	-1.76	-10.12

Fig. 3-4 continued

Operation:

- Service function *PRINT OTP Values*
- Press Execute softkey.
  The list is output to a connected printer.

The output of the error messages is left again by means of EXIT or using another function that calls up a menu on the display (e.g. RF or Floppy).

Setting the IF Attenuation (17 Set IF Att)

The function *17 Set IF Att* permits to set the IF attenuation manually.

Operation:

- Select function 17 Set IF Att.
- Press the Status ON/OFF softkey.
- The value of the IF attenuation is indicated on the display.
- By pressing the Status ON/OFF softkey, the value changes in 10-dB steps.

The service function is left by selecting a different service function, by means of EXIT or by selecting another menu.

Setting Control Outputs at the ANTENNA CODE Socket (18 Set ANTENNA CODE)

For testing the control outputs (FREQ 1 and FREQ 2) of the ANTENNA CODE socket, the service function *18 Set ANTENNA CODE* is provided. This function sets both outputs to High or Low.

Operation:

- Select function *18 Set ANTENNA CODE*. The current status is indicated on the display.
- *18 Set ANTENNA CODE Hi* appears on the display. Both outputs are set to high level.
- By pressing the Status ON/OFF softkey, the two outputs change to low level.

The service function is left by selecting a different service function, by means of EXIT or by selecting another menu.

IEC-bus Commands for Servicing

The data request commands are characterized by an appended "?". They request the receiver to transfer data to the controller. The syntax used complies with the standard "EEE 488.2" valid since 11/87.

Note: *When reading in the data into the controller make sure that the terminators are correctly set. The R&S BASIC command for ASCII texts is IEC TERM 10, for binary data IEC TERM 1.*

A few headers can be abbreviated. The shortest possible notation is indicated in bold type in the table of commands.

Table 3-2 Service functions

Command	Data	Unit	Meaning
CALIBRATION:**A**MPLIFIER	-6.00...6.00 dB	**D**B	The gain of the calibration amplifier can be set in the range from -6 to +6 dB.
:**C**ORRECTION	**ON** **OF**F	---	Consideration of all calibration correction values in level measurement on/off
:**D**ATA?	binary data block	---	Output of calibration correction values in binary format. Further details are to be found in the following section "Structure and Format of Calibration Data"
:**G**ENERATOR	**CAL_25**HZ **CAL_100H**Z **CAL_100K**HZ **OF**F	---	Switching on of the various calibration generators. The assignment of generators to types of receiver is explained in section „Service Selftest".
:**L**INCORR	**ON** **OF**F	---	Consideration of linearity correction values in level measurement on/off.
:**P**RINT	---	---	Output of a list with the calibration correction values on the connected printer
SERVICE:**LE**DS	**ON** **OF**F	---	Switching on and off of all LEDs on the front panel. A valid setting representing the actual parameters can best be restored by programming *RST
:**LC**DS	**ON** **OF**F	---	Switching on and off of all segments of the LCD for frequency and level indication. A valid setting representing the actual parameters can best be restored by programming *RST
:**F**LASHCYCLES :**F**LASHCYCLES?	1...n	---	Number of firmware updates performed.
:**O**PTIME :**O**PTIME?	hh,mm hh...hours mm...minutes	---	Readout and, if necessary, setting of operating hours meter. The time is indicated in hours and minutes, separated by a comma.

Command	Data	Unit	Meaning
:PONCYCLES :PONCYCLES?	1...n	---	Number of switch-on procedures of the instrument. In the case of the 3 commands described last programming should only be used if the static RAM has been deleted completely and the original numbers is known. Of course, these values are maintained after switching off the instrument, after a cold start or a firmware update.
:**S**ELFTEST:**AL**L	---	---	Performing a complete instrument selftest.
:**AN**TENNACODE	**ON** **OF**F	---	Switching on and off the outputs of the antenna code socket.
:**IF**ATTEN	-10...40 dB	**D**B	Setting the IF attenuation
SERVICE:**S**ELFTEST:**B**OARD?		---	Selftest at board level: Performing a previously selected test function (TF). The voltage measured is output in volts. n is the number of the test function in question. The commands should only be used if the corresponding board is provided in the instrument.
:**D**ETECTOR	n	---	Select TF on Detector Board
:**I**FANALYSIS	n	---	Select TF on IF Analysis
:**P**RESELECTOR	n	---	Select TF on Preselector
:**SE**CMIXER	n	---	Select TF on 2nd Mixer
:**SU**PPLY	n	---	Select TF on Power Supply
:**SY**NTHESIZER	n	---	Select TF on Synthesizer
:**T**RACKGEN	n	---	Select TF on RF Tracking Generator
SYSTEM:**M**ESSAGE	n,"text" Value range of n for screen: 1-3...status line 4...status line, bold 5...heading for LC display: 1-4...1. to 4. Line "text"...ASCII Text	---	Output of a message on the left-hand LCD in the case of the models ESPC, ESHS10, ESVS10, ESVD and ESVB, or on the screen in the case of all other receivers.

Structure and Format of Calibration Data

The data block provided in the output buffer after command CALIBRATION:DATA? has been issued consists of two parts. First, it contains the date of the last calibration in plain text, eg *8. Nov 1997 13:45:10* or *not yet calibrated*, if there are no correction values.
The second part is constituted by the correction values proper. They are separated from the date by a comma and are headed by *#0* which means block data.
Structure of a data block:

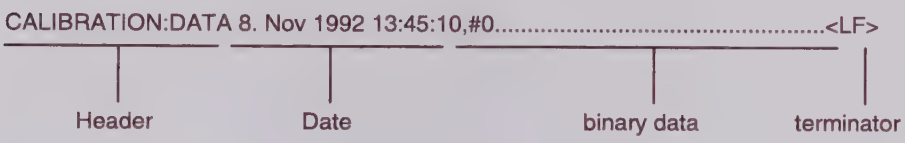


Table 3-3 Structure of binary data for receiver ESCS:

Offset	Meaning	Offset	Meaning
0	Prefix: #0	22	Linearity 60 10 dB
2	Absolute gain	24	Linearity 60 20 dB
4	IF bandwidth 200 Hz	26	Linearity 60 30 dB
6	IF bandwidth 120 kHz	28	Linearity 60 40 dB
8	IF bandwidth 1 MHz	30	Linearity 60 50 dB
10	IF attenuation 30 dB	32	Linearity 60 60 dB
12	IF attenuation 20 dB	34	Quasipeak Band A
14	IF attenuation 10 dB	36	Quasipeak Band B
16	IF attenuation 0 dB	38	Quasipeak Band C
18	IF attenuation -10 dB	40	Offset 200 Hz-IF filter
20	Linearity 60 0 dB		

Frequency response without preamplifier											
42	100 kHz	96	70.9 MHz	150	320.9 MHz	204	580.9 MHz	258	850.9 MHz	312	1550.9 MHz
44	200 kHz	98	79.9 MHz	152	330.9 MHz	206	590.9 MHz	260	860.9 MHz	314	1600.9 MHz
46	500 kHz	100	80.4 MHz	154	340.9 MHz	208	600.9 MHz	262	870.9 MHz	316	1650.9 MHz
48	1 MHz	102	90.9 MHz	156	350.9 MHz	210	610.9 MHz	264	880.9 MHz	318	1700.9 MHz
50	1.8 MHz	104	100.9 MHz	158	360.9 MHz	212	620.9 MHz	266	890.9 MHz	320	1750.9 MHz
52	1.9 MHz	106	110.9 MHz	160	370.9 MHz	214	630.79 MHz	268	900.9 MHz	322	1800.9 MHz
54	2.4 MHz	108	120.9 MHz	162	380.9 MHz	216	640.9 MHz	270	910.9 MHz	324	1850.9 MHz
56	2.9 MHz	110	130.9 MHz	164	390.9 MHz	218	650.9 MHz	272	920.9 MHz	326	1900.9 MHz
58	3.9 MHz	112	140.9 MHz	166	400.9 MHz	220	660.9 MHz	274	930.9 MHz	328	1959.9 MHz
60	5.9 MHz	114	150.9 MHz	168	410.9 MHz	222	670.9 MHz	276	940.9 MHz	330	1960.4 MHz
62	7.9 MHz	116	160.9 MHz	170	420.9 MHz	224	680.9 MHz	278	950.9 MHz	332	2000.9 MHz
64	8.4 MHz	118	170.9 MHz	172	430.9 MHz	226	690.9 MHz	280	960.9 MHz	334	2050.9 MHz
66	8.9 MHz	120	180.9 MHz	174	440.9 MHz	228	700.9 MHz	282	970.9 MHz	336	2100.9 MHz
68	9.9 MHz	122	190.9 MHz	176	450.9 MHz	230	710.9 MHz	284	980.9 MHz	338	2150.9 MHz
70	14.9 MHz	124	199.9 MHz	178	460.9 MHz	232	720.9 MHz	286	990.9 MHz	340	2200.9 MHz
72	19.9 MHz	126	200.4 MHz	180	470.9 MHz	234	730.9 MHz	288	999.9 MHz	342	2250.9 MHz
74	24.9 MHz	128	210.9 MHz	182	480.9 MHz	236	740.9 MHz	290	1000.4 MHz	344	2300.9 MHz
76	25.4 MHz	130	220.9 MHz	184	490.9 MHz	238	750.9 MHz	292	1050.9 MHz	346	2350.9 MHz
78	25.9 MHz	132	230.9 MHz	186	499.9 MHz	240	760.9 MHz	294	1100.9 MHz	348	2400.9 MHz
80	27.9 MHz	134	240.9 MHz	188	500.4 MHz	242	770.9 MHz	296	1150.9 MHz	350	2450.9 MHz
82	29.4 MHz	136	250.9 MHz	190	510.9 MHz	244	780.9 MHz	298	1200.9 MHz	352	2499.9 MHz
84	29.9 MHz	138	260.9 MHz	192	520.9 MHz	246	790.9 MHz	300	1250.9 MHz	354	2550.9 MHz
86	30.4 MHz	140	270.9 MHz	194	530.9 MHz	248	800.9 MHz	302	1300.9 MHz	356	2600.9 MHz
88	30.9 MHz	142	280.9 MHz	196	540.9 MHz	250	810.9 MHz	304	1350.9 MHz	358	2650.9 MHz
90	40.9 MHz	144	290.9 MHz	198	550.9 MHz	252	820.9 MHz	306	1400.9 MHz	360	2700.9 MHz
92	50.9 MHz	146	300.9 MHz	200	560.9 MHz	254	830.9 MHz	308	1450.9 MHz	362	2749.9 MHz
94	60.9 MHz	148	310.9 MHz	202	570.9 MHz	256	840.9 MHz	310	1500.9 MHz		

Frequency response with preamplifier											
364	100 kHz	418	70.9 MHz	472	320.9 MHz	526	580.9 MHz	580	850.9 MHz	634	1550.9 MHz
366	200 kHz	420	79.9 MHz	474	330.9 MHz	528	590.9 MHz	582	860.9 MHz	636	1600.9 MHz
368	500 kHz	422	80.4 MHz	476	340.9 MHz	530	600.9 MHz	584	870.9 MHz	638	1650.9 MHz
370	1 MHz	424	90.9 MHz	478	350.9 MHz	532	610.9 MHz	586	880.9 MHz	640	1700.9 MHz
372	1.8 MHz	426	100.9 MHz	480	360.9 MHz	534	620.9 MHz	588	890.9 MHz	642	1750.9 MHz
374	1.9 MHz	428	110.9 MHz	482	370.9 MHz	536	630.79 MHz	590	900.9 MHz	644	1800.9 MHz
376	2.4 MHz	430	120.9 MHz	484	380.9 MHz	538	640.9 MHz	592	910.9 MHz	646	1850.9 MHz
378	2.9 MHz	432	130.9 MHz	486	390.9 MHz	540	650.9 MHz	594	920.9 MHz	648	1900.9 MHz
380	3.9 MHz	434	140.9 MHz	488	400.9 MHz	542	660.9 MHz	596	930.9 MHz	650	1959.9 MHz
382	5.9 MHz	436	150.9 MHz	490	410.9 MHz	544	670.9 MHz	598	940.9 MHz	652	1960.4 MHz
384	7.9 MHz	438	160.9 MHz	492	420.9 MHz	546	680.9 MHz	600	950.9 MHz	654	2000.9 MHz
386	8.4 MHz	440	170.9 MHz	494	430.9 MHz	548	690.9 MHz	602	960.9 MHz	656	2050.9 MHz
388	8.9 MHz	442	180.9 MHz	496	440.9 MHz	550	700.9 MHz	604	970.9 MHz	658	2100.9 MHz
390	9.9 MHz	444	190.9 MHz	498	450.9 MHz	552	710.9 MHz	606	980.9 MHz	660	2150.9 MHz
392	14.9 MHz	446	199.9 MHz	500	460.9 MHz	554	720.9 MHz	608	990.9 MHz	662	2200.9 MHz
394	19.9 MHz	448	200.4 MHz	502	470.9 MHz	556	730.9 MHz	610	999.9 MHz	664	2250.9 MHz
396	24.9 MHz	450	210.9 MHz	504	480.9 MHz	558	740.9 MHz	612	1000.4 MHz	666	2300.9 MHz
398	25.4 MHz	452	220.9 MHz	506	490.9 MHz	560	750.9 MHz	614	1050.9 MHz	668	2350.9 MHz
400	25.9 MHz	454	230.9 MHz	508	499.9 MHz	562	760.9 MHz	616	1100.9 MHz	670	2400.9 MHz
402	27.9 MHz	456	240.9 MHz	510	500.4 MHz	564	770.9 MHz	618	1150.9 MHz	672	2450.9 MHz
404	29.4 MHz	458	250.9 MHz	512	510.9 MHz	566	780.9 MHz	620	1200.9 MHz	674	2499.9 MHz
406	29.9 MHz	460	260.9 MHz	514	520.9 MHz	568	790.9 MHz	622	1250.9 MHz	676	2550.9 MHz
408	30.4 MHz	462	270.9 MHz	516	530.9 MHz	570	800.9 MHz	624	1300.9 MHz	678	2600.9 MHz
410	30.9 MHz	464	280.9 MHz	518	540.9 MHz	572	810.9 MHz	626	1350.9 MHz	680	2650.9 MHz
412	40.9 MHz	466	290.9 MHz	520	550.9 MHz	574	820.9 MHz	628	1400.9 MHz	682	2700.9 MHz
414	50.9 MHz	468	300.9 MHz	522	560.9 MHz	576	830.9 MHz	630	1450.9 MHz	684	2749.9 MHz
416	60.9 MHz	470	310.9 MHz	524	570.9 MHz	578	840.9 MHz	632	1500.9 MHz		

Offset	Meaning	Offset	Meaning
686	IF analysis, reference	690	Resolution bandwidth 3 kHz
688	20-dB attenuation	692	Resolution bandwidth 1 kHz

Linearity correction of IF analysis, correction values 0 to 255											
694	0	780	43	866	86	952	129	1038	172	1124	215
696	1	782	44	868	87	954	130	1040	173	1126	216
698	2	784	45	870	88	956	131	1042	174	1128	217
700	3	786	46	872	89	958	132	1044	175	1130	218
702	4	788	47	874	90	960	133	1046	176	1132	219
704	5	790	48	876	91	962	134	1048	177	1134	220
706	6	792	49	878	92	964	135	1050	178	1136	221
708	7	794	50	880	93	966	136	1052	179	1138	222
710	8	796	51	882	94	968	137	1054	180	1140	223
712	9	798	52	884	95	970	138	1056	181	1142	224
714	10	800	53	886	96	972	139	1058	182	1144	225
716	11	802	54	888	97	974	140	1060	183	1146	226
718	12	804	55	890	98	976	141	1062	184	1148	227
720	13	806	56	892	99	978	142	1064	185	1150	228
722	14	808	57	894	100	980	143	1066	186	1152	229
724	15	810	58	896	101	982	144	1068	187	1154	230
726	16	812	59	898	102	984	145	1070	188	1156	231
728	17	814	60	900	103	986	146	1072	189	1158	232
730	18	816	61	902	104	988	147	1074	190	1160	233
732	19	818	62	904	105	990	148	1076	191	1162	234
734	20	820	63	906	106	992	149	1078	192	1164	235
736	21	822	64	908	107	994	150	1080	193	1166	236
738	22	824	65	910	108	996	151	1082	194	1168	237
740	23	826	66	912	109	998	152	1084	195	1170	238
742	24	828	67	91	110	1000	153	1086	196	1172	238
744	25	830	68	916	111	1002	154	1088	197	1174	240
746	26	832	69	918	112	1004	155	1090	198	1176	241
748	27	834	70	920	113	1006	156	1092	199	1178	242
750	28	836	71	922	114	1008	157	1094	200	1180	243
752	29	838	72	924	115	1010	158	1096	201	1182	244
754	30	840	73	926	116	1012	159	1098	202	1184	245
756	31	842	74	928	117	1014	160	1100	203	1186	246
758	32	844	75	930	118	1016	161	1102	204	1188	247
760	33	846	76	932	119	1018	162	1104	205	1190	248
762	34	848	77	934	120	1020	163	1106	206	1192	249
764	35	850	78	936	121	1022	164	1108	207	1194	250
766	36	852	79	938	122	1024	165	1110	208	1196	251
768	37	854	80	940	123	1026	166	1112	209	1198	252
770	38	856	81	942	124	1028	167	1114	210	1200	253
772	39	858	82	944	125	1030	168	1116	211	1202	254
774	40	860	83	946	126	1032	169	1118	212	1204	255
776	41	862	84	948	127	1034	170	1120	213		
778	42	864	85	950	128	1036	171	1122	214		

Measuring Instruments and Auxiliary Equipment

Item	Type of instrument	Required specifications	Appropriate R&S device	Order no.
1	Digital multimeter			
2	Frequency counter	Accuracy>1x10^{-9} Sensitivity<1 V		
3	Signal generator	Accuracy<1x10^{-8} 9 kHz to 2750 MHz	SMHU	801.0001.52 802.005.02
4	Signal generator	9 kHz to 2750 MHz	SME	1038.6002.03
5	3-dB coupler	Decoupling >20 dB		
6	Attenuator pad 6 dB		DNF	274.4110.50
7	Attenuator pad 10 dB		DNF	274.4210.50
8	Spectrum analyzer	9 kHz jto 2750 MHz	FSEA	
9	RMS voltmeter		URE2 with 50-Ω-feed-through termination	350.3315.02
10	Power meter		NRV with Sensor NRV-Z5	349.80.12.02
11	Pulse generator	3-standard pulse generator calibrated at 1 MHz to 80 dBµV /MHz ±0.1 dB		
12	Attenuator	Attenuation corrected; max. error (9 kHz to 2750 MHz) 0.1 dB	RSP	831.315.02
13	50-Ω-feedthrough termination	(9 kHz to 30 MHz)		
14	SWR bridge	9 kHz to 30 MHz/ 30 to 2750 MHz		

Board Replacement

Opening the Instrument

- Switch off instrument and pull the power plug.
- Loosen 4 Phillips screws in the two rear-panel feet and pull off towards the rear.
- Withdraw the upper and lower instrument cover towards the rear.

Battery Replacement

The instrument contains a lithium battery for backup of the static RAM. Its lifetime at normal ambient temperatures (<30 °C) is approx. 5 years. If the battery is flat, the data stored in the CMOS RAM will be lost when the instrument is switched off. This backup battery is accommodated on the board A220 (CPU-BOARD). It can be replaced as follows:

- Remove instrument cover
- Remove CPU board.
- Unsolder the flat battery.
  The following types of battery are permissible for replacement:
  SAFT LS14250CNA (R&S order no. 565.1687)
  Sonnenschein SL-750/P (R&S order no. 565.1687)

- When soldering the new battery in place make sure not to reverse the polarity:

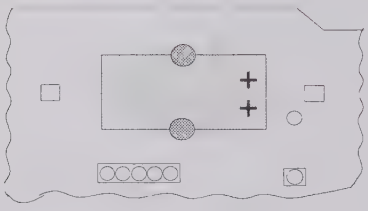


Fig. 3-1 How to mount the battery

Removing a Board from the Instrument

- Place the instrument upside down.

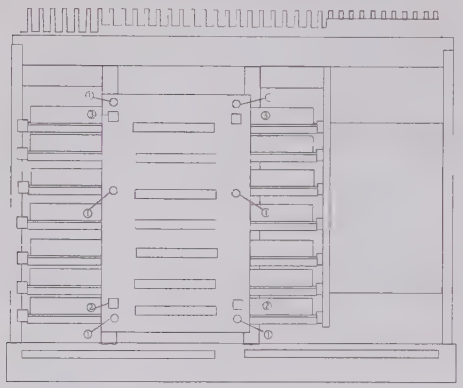


Fig. 3-2 Bottom view of open instrument

- Loosen 6 Phillips screws (**do not remove**!).
- Using a screwdriver push the two securing rails towards the front panel (see notes BOARDS UNLOCK).
- Removing the CPU board:
  - Disconnect two flat cables at the bottom and one flat cable at the top side of the instrument.
- Removing the remaining boards:
  - Unplug the SMB RF connector from the board to be replaced.
  - In the case of the FRONTEND, additionally unscrew the SMA RF connector.
  - Carefully press the board towards the top and out of the instrument.

Replacing a Board

- Carefully slide the board from above into the instrument. Take care not to catch any cable. The top of each board (to be recognized by the cover with the service inscription) must point towards the rear panel.
- Remount the SMA/SMB RF connector or the flat cable according to the inscription.
- Using a screwdriver carefully slide the board locking rails towards the rear panel (see notes BOARDS LOCK). If the locking rails cannot be easily slided until the end, the board has not been inserted correctly.
- Tighten 6 Phillips screws.

Putting the Receiver into Operation after Board Replacement

➢ Switch on receiver.

Caution! *Observe the safety regulations!*

Note: *No adjustment is required after replacing the CPU board.*

After replacing the CPU BOARD set the DIP switch as follows using a pointed object:

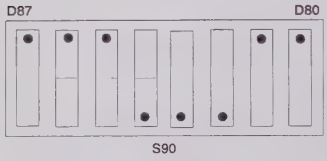


Fig. 3-3 DIP switch

➢ Switch on receiver.

➢ If required, install a new instrument firmware using an AT (see section 4).

After replacement of the Frontend, Synthesizer, 2nd Mixer or If Selection Board:

➢ Perform instrument cold start.

➢ Adjustment in the range <1GHz using R300 on the IF Selection Board

Instrument settings:

RF ATT:	20dB
Freq:	5,9MHz
Detector:	AV
IF BW:	9 kHz
CALGEN	100kHz on

➢ Adjustment using R300 to 60dBµV.

➢ Perform calibration.

➢ Call up the function *IF Gain Adj* in the selftest menu.

➢ Vary the level display according to *ADJ VHF* using R300.

➢ Perform calibration.

➢ Call up the function *IF Gain Adj* in the selftest menu.
The values for 5.9 MHz MIN MAX and <1 GHz MIN MAX should now comply with the tolerance.
Tolerance for 5.9 MHz: ±4 dB and for <1 GHz: ± 8 dB.
If this is not the case, vary R300 again.
Perform new calibration and check the new deviations by means of IF GAIN ADJ.
Repeat this procedure until the values are no longer out of tolerance.

➢ Adjustment in the range >1GHz using R361 on the SYNTHESIZER UNIT and R10 on the FRONTEND

Instrument settings:

RF ATT:	10dB
Freq:	1100MHz
Detector:	AV
IF BW:	9 kHz
CALGEN	100kHz ON

➢ Perform calibration.

➢ Call up the function *IF Gain Adj* in the selftest menu.

➢ Vary the level display according to *ADJ UHF* using R361 and R10.

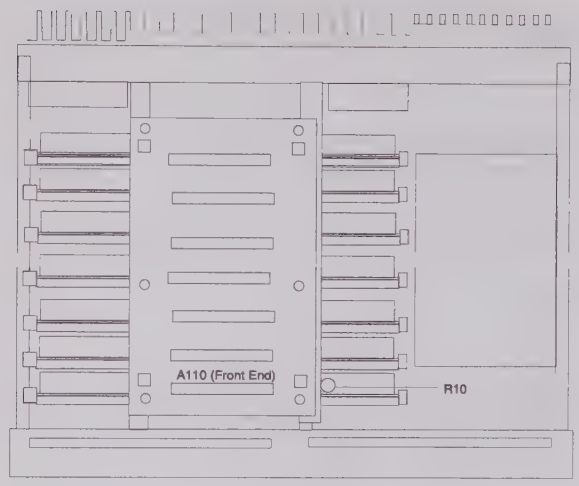


Fig. 3-4 Position of potentiometer R10 (bottom view of instrument)

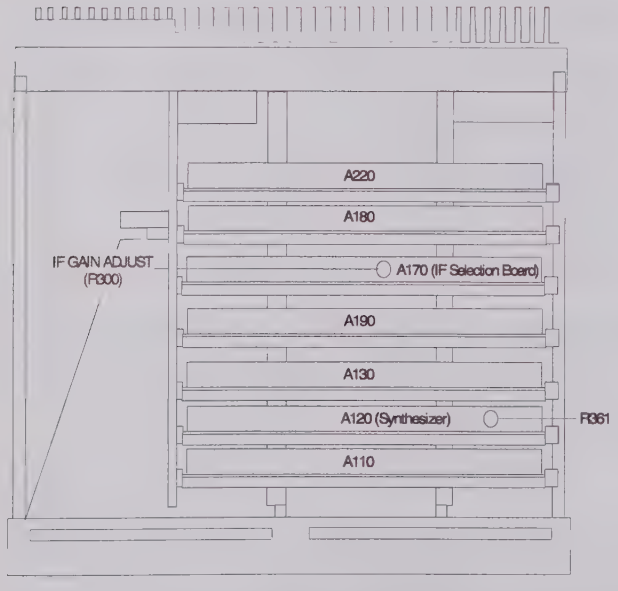


Fig. 3-5 Position of potentiometers R300 and R361 (top view of instrument)

- Perform calibration.
- Call up the function *IF Gain Adj* in the selftest menu.
  The values for >1 GHz MIN MAX should now comply with the tolerance.
  Tolerance for >1 GHz: ± 8 dB.
  If this is not the case, vary R361 or R10 once again.
  Perform a new calibration and check the new deviations by means of IF GAIN ADJ.
  Repeat this procedure until the values are no longer out of tolerance.

Following replacement of the detector board:

- Instrument settings: RF ATT: 0dB
  Freq: 5.9MHz
  Detector: Pk

IF BW:	120 kHz
MODE:	Low Distortion
MEAS TIME:	100 ms
CALGEN	100 kHz on

- Use R654 on the detector board (METER FULL SCALE) to set the meter indication to 50 ±0.5 dB.
- Set the attenuator to 50-dB attenuation.
- Use R631 on the detector board (METER ZERO 60 DB) to set the voltage at the recorder output to 0.75 V ±50 mV.
- Repeat the adjustment until the values are optimally set.
- Set the attenuator to 10-dB attenuation.
- Repeatedly switch the cal generator off and on and set R652 (METER SPEED) on the detector board such that the pointer of the meter overshoots minimally when the cal generator is switched on.

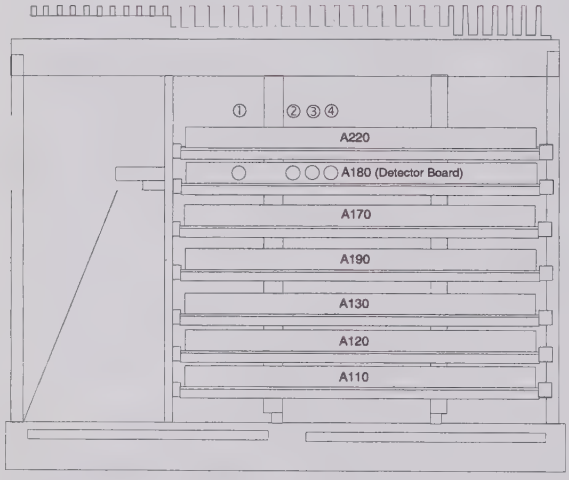


Fig. 3-6 Position of potentiometer on the DETECTOR BOARD.

Following replacement of the IF ANALYSIS:

- Perform calibration.
- Determine the maximum negative value of the frequency response correction from the printout of the cal values (= K_{max}).
- Perform cold start.
- Connect a signal generator to the ESCS.

Settings on signal generator:	Frequency	5.9 MHz
	Level:	60 dBµV
Settings on the ESCS:	Frequency	5.9 MHz
	RF ATT	0 dB
	IF Analysis	On

- Tune the ESCS to 5.9 MHz again.
- Set Marker to Peak einstellen.
- Set R293 on the IF ANALYSIS such that the marker level displayed is 60 dBµV - K_{max}.

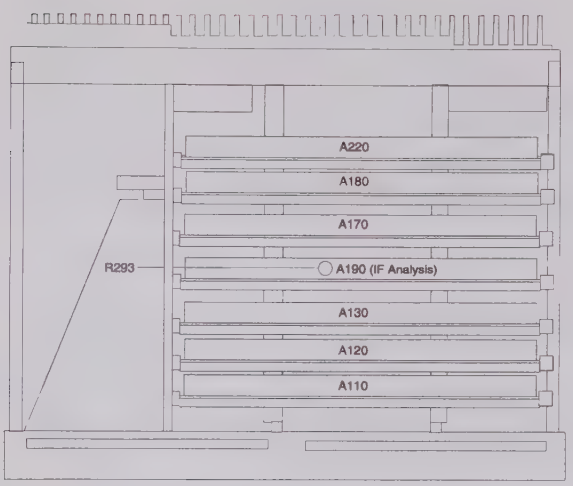


Fig. 3-7 Position of potentiometer on IF Analysis.

Following replacement of the TRACKING GENERATOR:

- Connect power meter to the GEN OUTPUT connector.
  Settings on the ESCS: Frequency 100 MHz
  Tracking Generator: On
- Adjust level to -17 dBm ± 0.1 dBm using R24 on the tracking generator.

Following replacement of the BATTERY CTRL BOARD or of the battery pack:

- Operate the instrument from the AC supply until the batteries are charged (fan is switched off).
- After the end of charge pull the power plug and operate the instrument continuously until it is switched off automatically.
- Operate the instrument from the AC supply again and charge the batteries. The current residual operating time is indicated on the display.
- Finally, start the selftest.
  If all boards work properly and the RF cables have been fitted correctly, the message *Instrument ok* will appear on the screen after termination of the selftest.

Troubleshooting

To facilitate troubleshooting 3 selftest functions are provided:

- The user selftest is used to locate the fault on a particular board.
- The service selftest additionally indicates the faulty functional unit on the relevant boards.
- After the automatic test has been performed, the board test permits specific investigation of individual circuit parts of a board.
- Based on the error symptoms, the associated troubleshooting charts also facilitate troubleshooting.

Note: *Since the signal level generated by the calibration generators is not sufficient in order to be analyzed by the level detectors accommodated on the frontend, 2nd mixer and IF selection board, a fault in the signal path must be located in the frontend, 2nd mixer or IF selection board by means of a signal generator and a spectrum analyzer.*

No or Faulty Response on Switch-on

For all error symptoms described in the following, further troubleshooting uses the troubleshooting charts of the service instructions for the REAR PANEL.

- The standby LED is not illuminated in the case of AC supply, activated power switch and if the switch is in the standby position.
- The supply OK LED is not illuminated for 1 to 2 s after pressing of the on/off switch if the instrument is operated from the AC supply, external battery or internal battery.
- The instrument only switches on for 2 to 3 s after pressing of the on/off switch.

Note: *If only the standby LED flashes with internal or external battery supply and switch 9 pressed, first check the voltage at the respective battery input.*

Error Message in the Selftest

- CPU board error: see service instructions for "CPU Board"
- Faults in the signal processing or in the synthesizer: Locate the fault using the board test function (selftest 9) with the aid of the troubleshooting chart in the service instructions for the respective board.

Error Message during Calibration

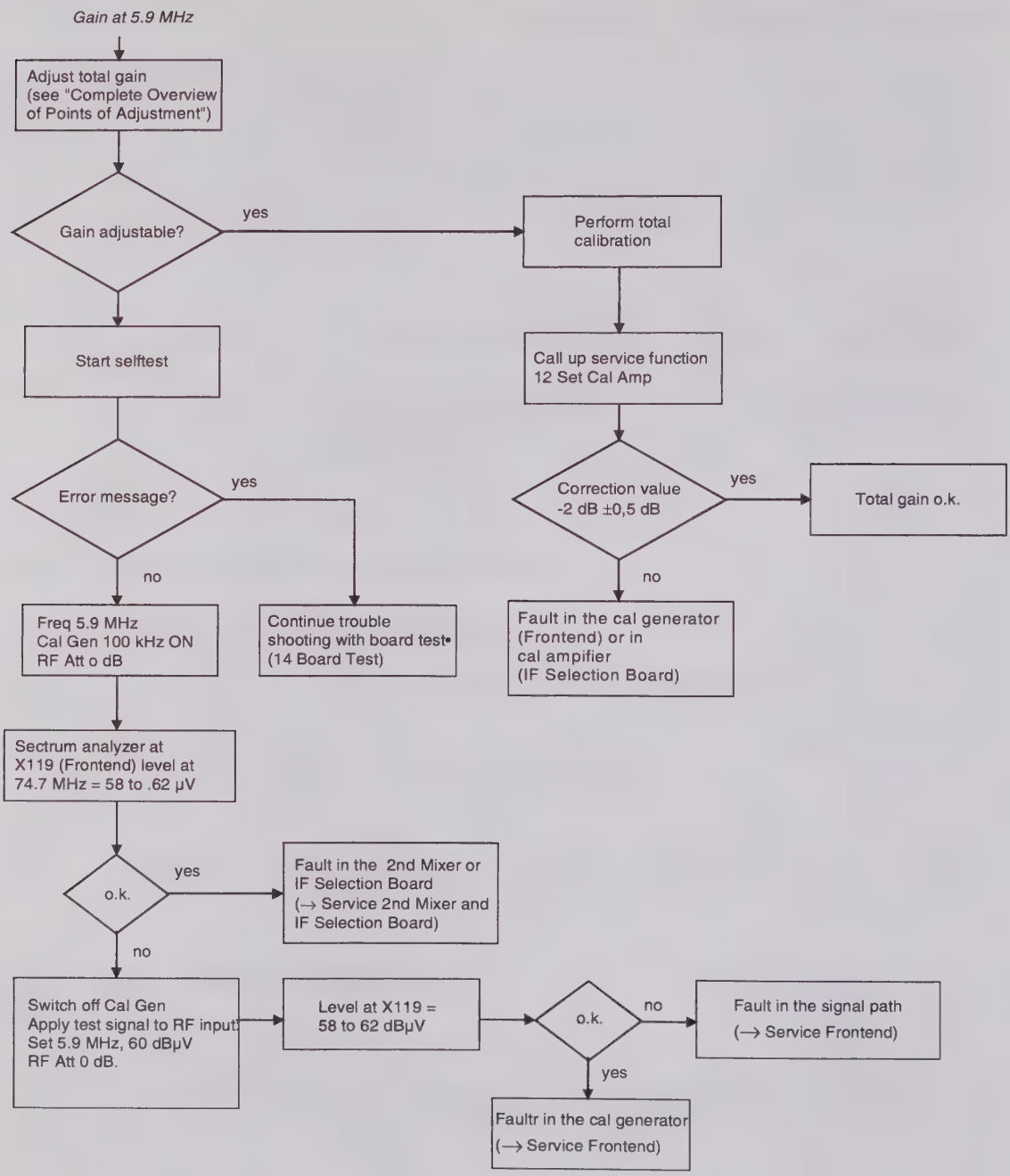
If, following a calibration, one of the warnings or error messages described in the operating manual appears, it is recommended to output the calibration correction values to a connected printer using service function 15 Print Cal Values. If the 5.9-MHz correction value exceeds ±6 dB, an error message is displayed on the screen. The correction values resulting from the adjustment tolerances of the boards, however, are considerably smaller; Fig. 3-3 shows the printout of the calibration correction values with new boards at room temperature.

Troubleshooting:

* Message: *WARN/ERR:Gain at 5.9 MHz*
Correction value: *abs reference at 5.9 MHz*
Nominal value: *60 dBµV*

Receiver setting when recording the correction value:

RF attenuation dB	
IF bandwidth	10 kHz
IF attenuation dB	
Detector	AV
Meas. time	100 ms
Display in the meas. range 0...60 dB	30 dB


Gain at 5.9 MHz
Adjust total gain
(see "Complete Overview
of Points of Adjustment")
Gain adjustable?
yes
Perform total
calibration
Start selftest
Call up service function
12 Set Cal Amp
Error message?
yes
Correction value
-2 dB ±0,5 dB
yes
Total gain o.k.
no
no
Freq 5.9 MHz
Cal Gen 100 kHz ON
RF Att o dB
Continue trouble
shooting with board test•
(14 Board Test)
Fault in the cal generator
(Frontend) or in
cal ampifier
(IF Selection Board)
Sectrum analyzer at
X119 (Frontend) level at
74.7 MHz = 58 to .62 µV
o.k.
yes
Fault in the 2nd Mixer or
IF Selection Board
(→ Service 2nd Mixer and
IF Selection Board)
no
Switch off Cal Gen
Apply test signal to RF input
Set 5.9 MHz, 60 dBµV
RF Att 0 dB.
Level at X119 =
58 to 62 dBµV
o.k.
no
Fault in the signal path
(→ Service Frontend)
yes
Faultr in the cal generator
(→ Service Frontend)

- Message: *WARN/ERR: Gain at BW 200 Hz/10 kHz/120 kHz/1 MHz*
  Correction value: gain offset, IF BW 200 Hz/10 kHz/120kHz/1 MHz

Receiver setting when recording the correction value:

RF attenuation dB	
IF bandwidth	10 kHz
IF attenuation dB	
Detector	AV
Meas. time	100 ms

BW 200 Hz / 10kHz / 120 / kHz 1MHz

↓

Fault in IF Selection Board
(→ Service IF Selection Board)

- Message: ERR: *Gain at BW 200 Hz*

Since the 200-Hz filter may deviate from the nominal frequency by up to 200 Hz depending on the temperature, the current center frequency is determined prior to the recording of the bandwidth correction value and the synthesizer is offset by the frequency offset f_{Offset} depending on the range. The frequency offset is determined in a scan with the following settings:

Start freq:	5.89975 MHz
Stop freq:	5.90025 MHz
Stepsize:	10 Hz
IF BW:	200 Hz
Detector:	AV
Mode:	Low Noise
RF Att:	20 dB
Meas Time:	50 ms
Cal Gen:	100 kHz on

BW 200 Hz

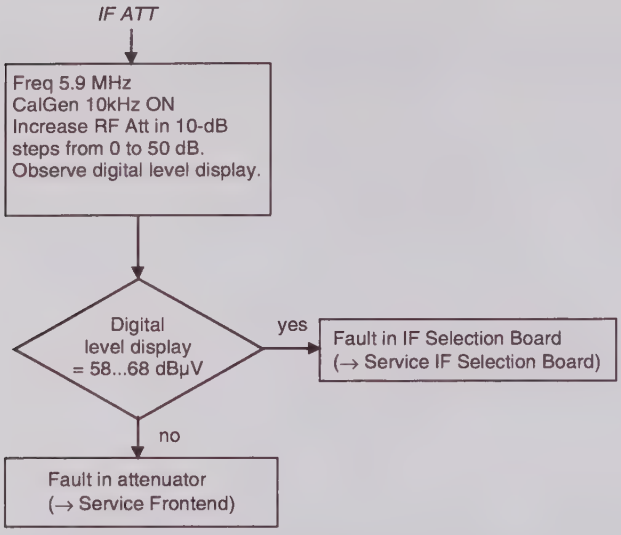
↓

Fault in IF Selection Board
(→ Service IF Selection Board)

- Message: *WARN/ERR:IF ATT*
  Correction value: *gain offset, IF ATT 30/20/10/0 dB*

Receiver setting when recording the correction values:

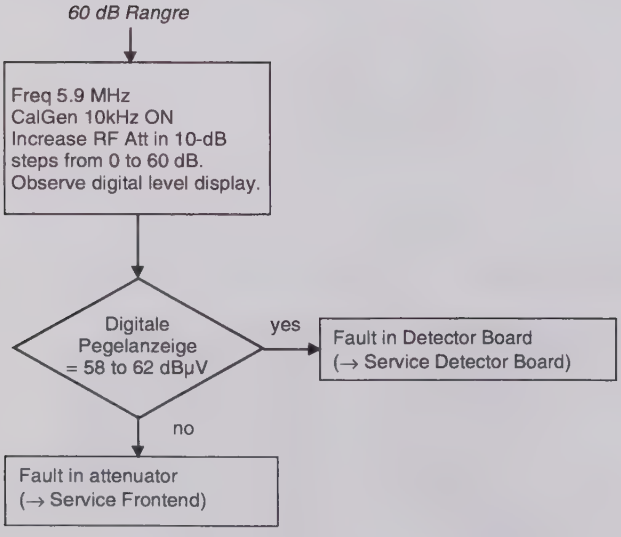
Frequency	5.9 MHz
RF attenuation	10 dB with IFATT 30dB
RF attenuation	20 dB with IFATT 20dB
RF attenuation	30 dB with IFATT 10dB
RF attenuation	40 dB with FATT 0 dB
RF attenuation	50 dB with IFATT -10dB
IF bandwidth	10 kHz
Detector	AV
Cal Gen	100 kHz



- Message: *WARN/ERR:60 dB Range*
  Correction value: linearity, 60 dB range

  Receiver setting when recording the correction values:

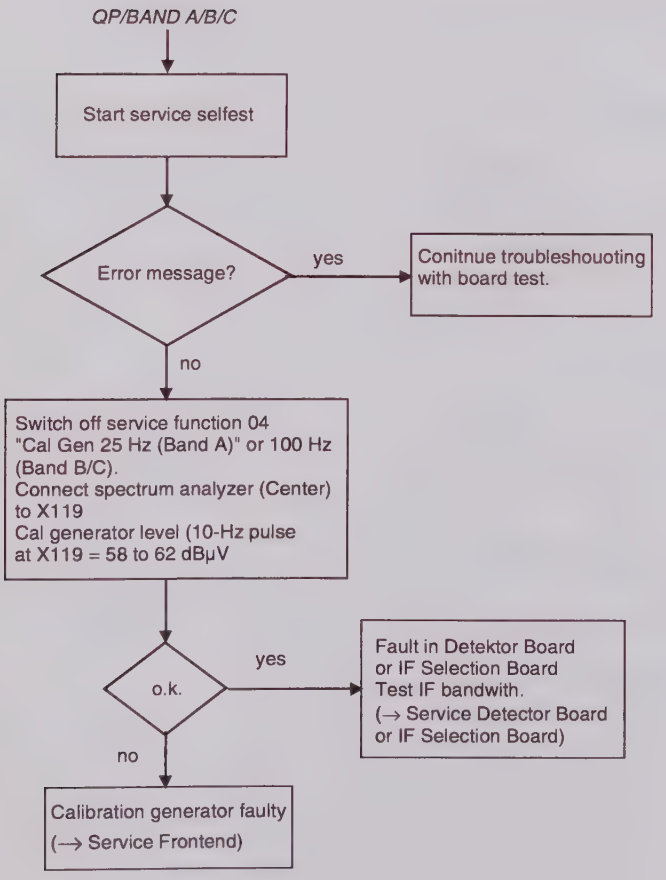
Frequency	5.9 MHz
RF attenuation	0 ... 60 dB
IF attenuation	40 dB
IF bandwidth	10 kHz
Detector	AV
Meas. time	100 ms
Cal Gen	100 kHz on



- Message: *WARN/ERR: QP/Band A/B/C*
  Correction value: *QP, Band A, B or C*
  Nominal value: *0.4 dBµV (Band A)*
  33.1 dBµV (Band B)
  50.0 BµV (Band C)

Receiver setting when recording the correction values:

	CISPR, Band A	CISPR, Band B	CISPR, Band C/D
Frequency	5.9 MHz	5.9 MHz	5.9 MHz
IF bandwidth	200 Hz	10 kHz	120 kHz
RF attenuation	10 dB	10 dB	20 dB
IF attenuation	0 dB	10 dB	20 dB
Detector	QP	QP	QP
Meas. time	1 s	1 s	1s
Display in measurement range 0 to 60 dB approx.	10 dB	20 dB	20 dB
RF pulse generator	25 Hz	100 Hz	100 Hz


QP/BAND A/B/C
Start service selfest
Error message?
yes
Conitnue troubleshouoting with board test.
no
Switch off service function 04
"Cal Gen 25 Hz (Band A)" or 100 Hz (Band B/C).
Connect spectrum analyzer (Center) to X119
Cal generator level (10-Hz pulse at X119 = 58 to 62 dBµV
o.k.
yes
Fault in Detektor Board or IF Selection Board
Test IF bandwith.
(→ Service Detector Board or IF Selection Board)
no
Calibration generator faulty
(→ Service Frontend)

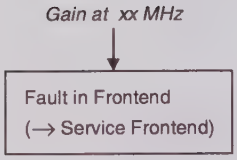
- Message: *WARN/ERR:Gain at xx MHz*
  Correction value: frequency

Range 9 kHz or 150 kHz ... ≤30 MHz:

In this frequency range, the low-frequency pulse generator is used for calibration.

- Receiver settings:

RF attenuation	10 dB
IF bandwidth	10 kHz
IF attenuation	10 dB
Detector	AV
Meas. time	100 ms
Display in meas. range 0 to 60 dB	50 dB

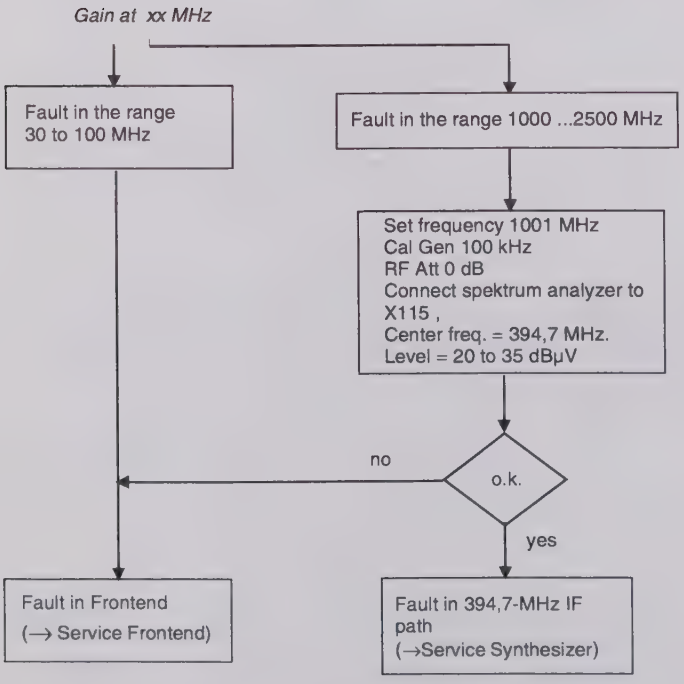


Range >30 ... 1000 or 2750 MHz:

In this range, the high-frequency pulse generator is used.

- Receiver settings:

RF attenuation	10 dB
IF bandwidth	10 kHz
IF attenuation	0 dB
Detector	AV
Meas. time	100 ms
Display in meas. range 0 ... 60 dB	30 dB

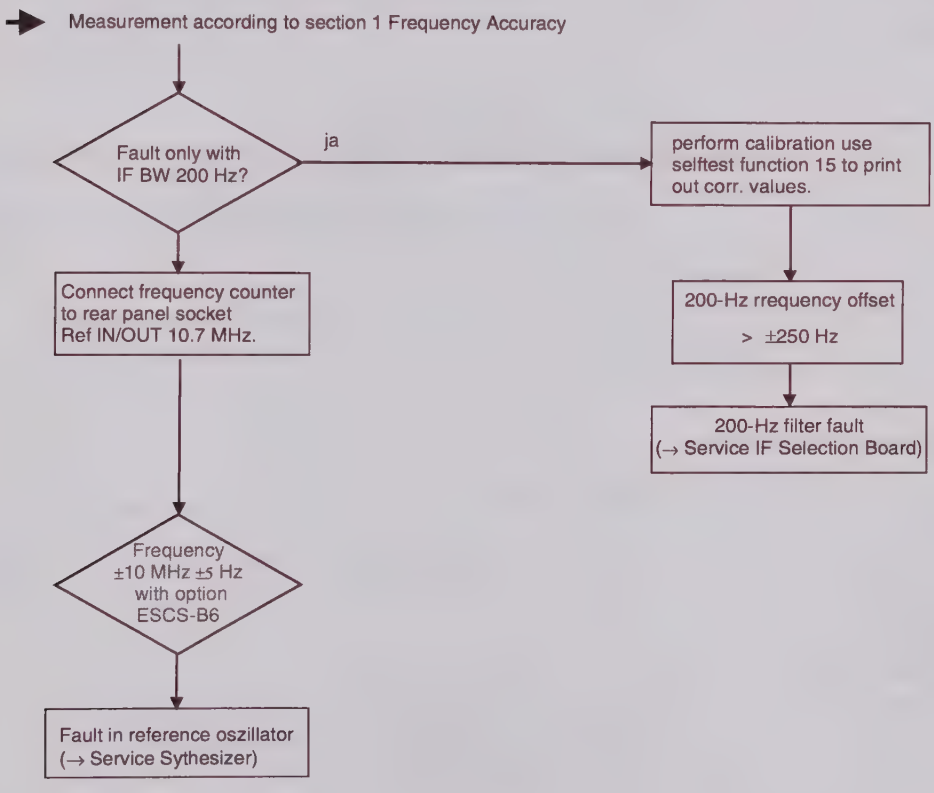

Gain at xx MHz
Fault in the range 30 to 100 MHz
Fault in the range 1000 ...2500 MHz
Set frequency 1001 MHz
Cal Gen 100 kHz
RF Att 0 dB
Connect spektrum analyzer to X115 ,
Center freq. = 394,7 MHz.
Level = 20 to 35 dBµV
o.k.
no
yes
Fault in Frontend
(→ Service Frontend)
Fault in 394,7-MHz IF path
(→Service Synthesizer)

Error when Testing the Rated Specifications

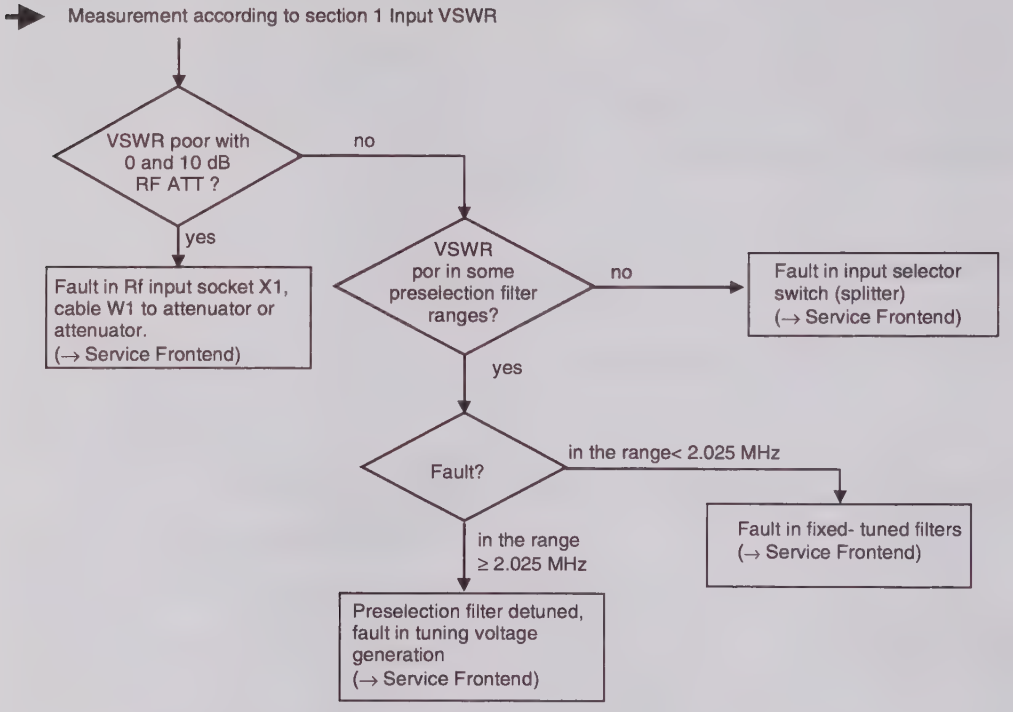
In the following, the assumption is made that

- the total calibration works without faults,
- no synthesizer error message appears and
- no error is signalled in the service selftest.

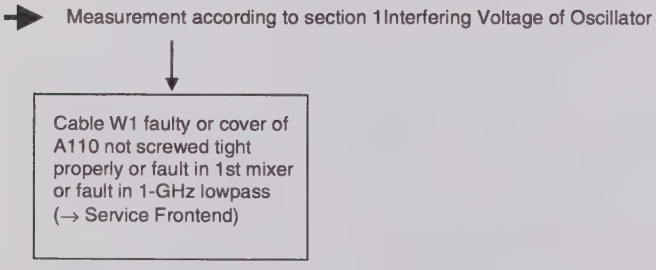
Frequency Accuracy


Measurement according to section 1 Frequency Accuracy
Fault only with IF BW 200 Hz?
ja
perform calibration use selftest function 15 to print out corr. values.
Connect frequency counter to rear panel socket Ref IN/OUT 10.7 MHz.
200-Hz rrequency offset
> ±250 Hz
200-Hz filter fault
(→ Service IF Selection Board)
Frequency ±10 MHz ±5 Hz with option ESCS-B6
Fault in reference oszillator
(→ Service Sythesizer)

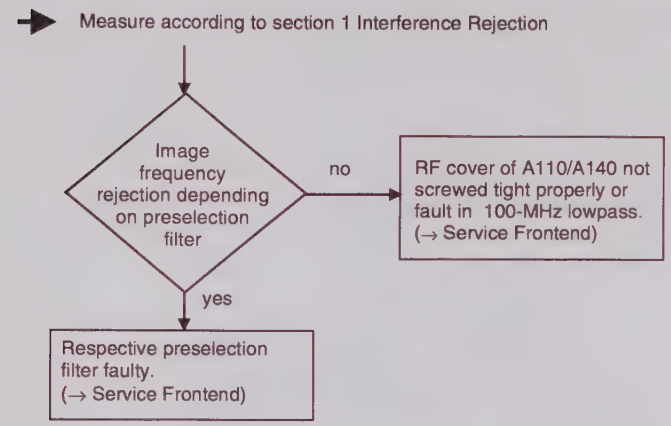
Input VSWR


Measurement according to section 1 Input VSWR
VSWR poor with 0 and 10 dB RF ATT ?
no
yes
Fault in Rf input socket X1, cable W1 to attenuator or attenuator. (→ Service Frontend)
VSWR por in some preselection filter ranges?
no
Fault in input selector switch (splitter) (→ Service Frontend)
yes
Fault?
in the range< 2.025 MHz
Fault in fixed- tuned filters (→ Service Frontend)
in the range ≥ 2.025 MHz
Preselection filter detuned, fault in tuning voltage generation (→ Service Frontend)

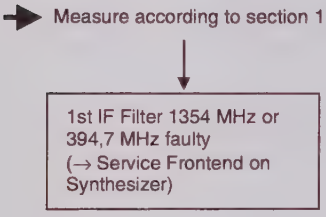
Interfering Voltage of Oscillator


Measurement according to section 1Interfering Voltage of Oscillator
Cable W1 faulty or cover of A110 not screwed tight properly or fault in 1st mixer or fault in 1-GHz lowpass (→ Service Frontend)

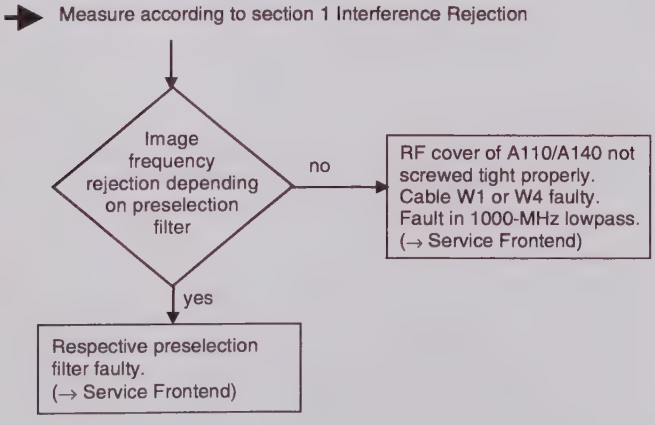
Interference Rejection, Image-frequency Rejection 1st IF


Measure according to section 1 Interference Rejection
Image frequency rejection depending on preselection filter
no
RF cover of A110/A140 not screwed tight properly or fault in 100-MHz lowpass. (→ Service Frontend)
yes
Respective preselection filter faulty. (→ Service Frontend)

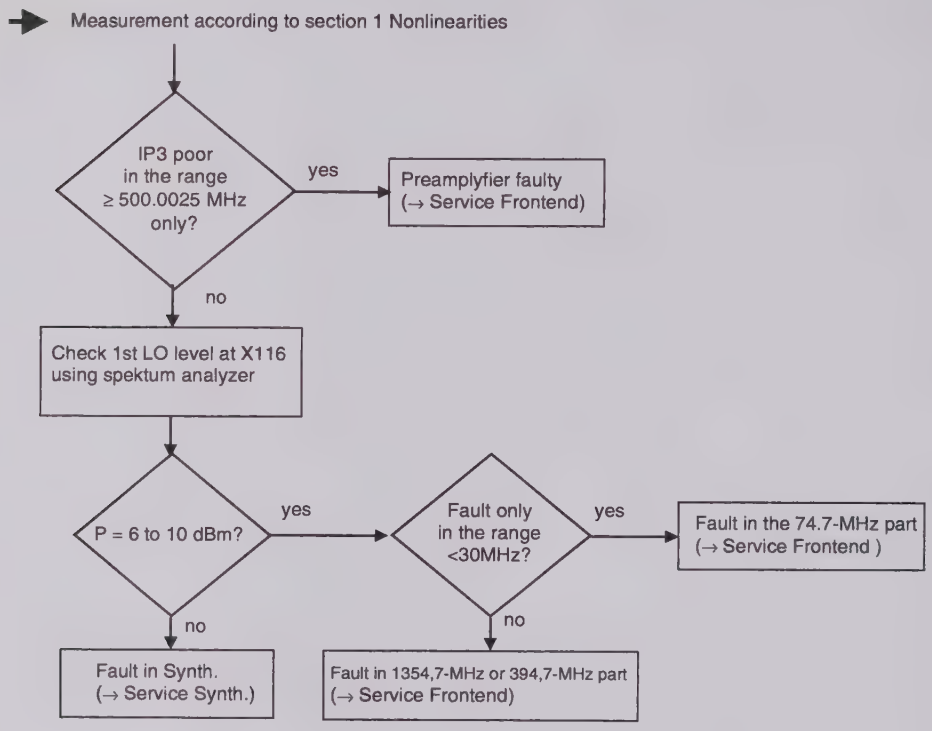
Interference Rejection, Image-frequency Rejection 2nd IF


Measure according to section 1 Interference Rejection
1st IF Filter 1354 MHz or 394,7 MHz faulty (→ Service Frontend on Synthesizer)

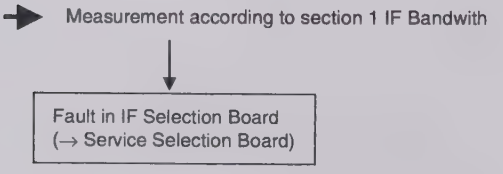
IF Interference Rejection


Measure according to section 1 Interference Rejection
Image frequency rejection depending on preselection filter
no
RF cover of A110/A140 not screwed tight properly. Cable W1 or W4 faulty. Fault in 1000-MHz lowpass. (→ Service Frontend)
yes
Respective preselection filter faulty. (→ Service Frontend)

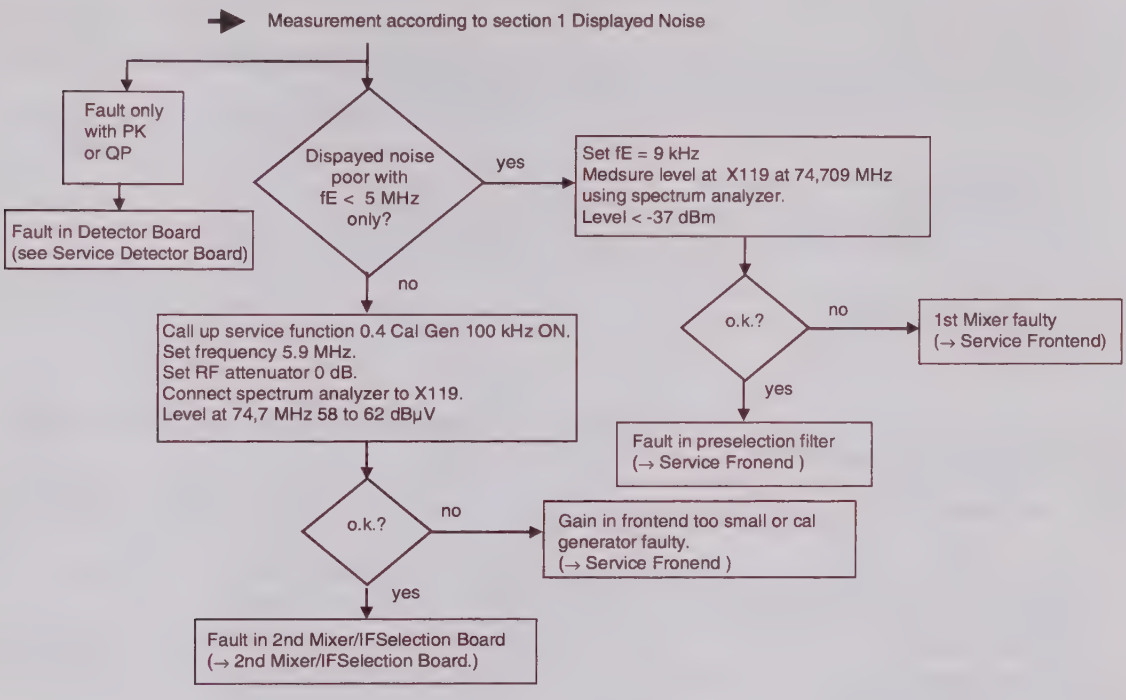
Nonlinearities


Measurement according to section 1 Nonlinearities
IP3 poor in the range ≥ 500.0025 MHz only?
yes
Preamplyfier faulty (→ Service Frontend)
no
Check 1st LO level at X116 using spektum analyzer
P = 6 to 10 dBm?
yes
Fault only in the range <30MHz?
yes
Fault in the 74.7-MHz part (→ Service Frontend)
no
Fault in Synth. (→ Service Synth.)
no
Fault in 1354,7-MHz or 394,7-MHz part (→ Service Frontend)

IF Bandwidths



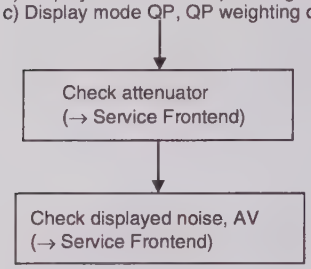
Displayed Noise


Measurement according to section 1 Displayed Noise
Fault only with PK or QP
Fault in Detector Board (see Service Detector Board)
Dispayed noise poor with fE < 5 MHz only?
yes
no
Set fE = 9 kHz
Medsure level at X119 at 74,709 MHz using spectrum analyzer.
Level < -37 dBm
o.k.?
no
1st Mixer faulty (→ Service Frontend)
yes
Fault in preselection filter (→ Service Fronend)
Call up service function 0.4 Cal Gen 100 kHz ON.
Set frequency 5.9 MHz.
Set RF attenuator 0 dB.
Connect spectrum analyzer to X119.
Level at 74,7 MHz 58 to 62 dBµV
o.k.?
no
Gain in frontend too small or cal generator faulty. (→ Service Fronend)
yes
Fault in 2nd Mixer/IFSelection Board (→ 2nd Mixer/IFSelection Board.)

Measurement Accuracy

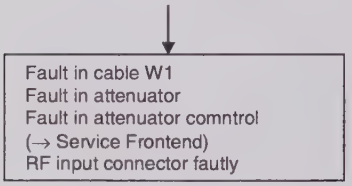
→ Measurement according to section 1 Measurement Accuracy

a) Frequency response → Fault in cal generator or attenuator → Service Frontend
b) Display mode PK with pulse signals → Check IF bandwiths → Service IF Sel Board
c) Display mode QP, QP weighting curve → Fault in Detektor Board → Service Detektor Board



Accuracy of Attenuator

→ Measurement according to section 1 Measurement Accuracy



Final Adjustment

Testing the PE Resistance

Measuring equipment: Ohmmeter (UDS5)

Test setup:
- Connect ohmmeter between ground socket X4 and PE connector of AC supply input X31. The resistance of the leads must be considered in the measurement.

Measurement The resistance to be measured is .....< 100 mΩ

Testing the AC Supply Voltage Rejection

Measuring equipment: High-voltage tester

Test setup:
- Connect neutral conductor and phase of X31.
  - Connect high-voltage tester petween phase and PE conductor of X31.

Measurement
- Set voltage at high-voltage tester to 1500 V.
  There must not be a flash-over to the housing, ie no current flows out of the high-voltage tester

Setting the -10-V Supply

Measuring equipment: UDS5

Stest setup:
- Connect the UDS5 to the motherboard of the ESCS between X18/AC1(ground) and the respective connector for the voltages at X18.

Measurement :
- Use R35 at the power supply (instrument top) to set the voltage at X18/AC5 to ..... -10 V ±1 mV
- Check the voltage at X18/AC4.
  Nominal value ..... +10 V ±20 mV
- Check the voltage at X18/AC2.
  Nominal value ..... +5.5 ±0.1 V
- Check the voltage at X18/AC3.
  Nominal value ..... 12.2...12.6 V
- Check the voltage at X18/AC6.
  Nominal value ..... +28 V ±30 mV

Testing the Linearity of Demodulator and Logarithmic Amplifier

Measuring equipment: Signal generator SMHU
Attenuator RSP

Test setup: Settings on the ESCS:

Frequency	1 MHz
Detector	AV
Meas Time	100 ms
IF BW	10 kHz
Mode	Low Noise
RF ATT	10 dB

Settings on signal generator:

Frequency	1 MHz
Level	70 dBµV

- ➢ Switch off all linearity correction values using the service function (LIN CORR. OFF)
- ➢ Connect RF output of signal generator to attenuator
- ➢ Connect attenuator output to RF input of ESCS
- ➢ Set attenuator to 0 dB attenuation
- ➢ Using the service function, set the calibration amplifier such that the level display indicates ESCS 60.3 dBµV

Measurement
- ➢ Increase attenuation in 10-dB steps to 60 dB.
  Level display according to the following table:

Attenuation	Level display on the ESCS
0 dB	60.3 dBµV ±0.8 dB
10 dB	49.8 dBµV ±0.8 dB
20 dB	39.7 dBµV ±0.8 dB
30 dB	29.7 dBµV ±0.8 dB
40 dB	19.7 dBµV ±0.8 dB
50 dB	9.8 dBµV ±0.8 dB
60 dB	0.1 dBµV ±1 dB

If the linearity is not observed, the envelope demodulator and the log amplifier must be readjusted.

Adjusting the Envelope Demodulator

Measuring equipment: Signal generator SMHU
Attenuator RSP (max. error: 0.1 dB)
Digital voltmeter UDS5

Note: *When measuring voltages of the board the negative input of the DVM must be connected to the ground of the board*

Test setup:
- ➢ Connect RF output of signal generator to attenuator.
- ➢ Connect attenuator output to RF input of ESCS.
- ➢ Set attenuation to 0 dB.

Signal generator setting:

Frequency	1 MHz
Level	70 dBµV

Settings on the ESCS:

Detector	AV
Meas Time	1 s

IF BW	10 kHz
Mode	Low Noise
RF ATT	10 dB

Adjustment:

- Measure voltage using DVM at X17C13 (VIDEO IN) on the IF Selection Board.
- Set attenuator to 0-dB attenuation.
- Using the service function set the calibration amplifier such that the voltage at X17C13 is 4 V ±0.1 V.
- Store voltage value (Shift Store).
- Set UDS5 to relative level measurement (ΔdB)
- Set attenuator to 60-dB attenuation.
- Use R520 (DEMOD OFFSET) to set relative level display at DVM to -60 dB ±0.1 dB

Adjusting the Logarithmic Amplifier

Measuring equipment: See adjustment of envelope demodulator.

Test setup: See adjustment of envelope demodulator

Adjustment:

- Measure voltage with DVM at X18C15 on detector board.
- Repeat the following adjustment until the voltages are exactly set to ± 3 mV:
  - Set attenuator to 0 dB
  - Using R529 (LOG GAIN) on the detector board set the voltage at X18C15 to ..... 4.654 V
  - Set the attenuator to 60 dB.
  - Using R524 (LOG REF) on the detector board set the voltage at X18C15 to ..... 0.982 V

Adjusting the Meter

Measuring equipment: See adjustment of envelope demodulator

Test setup: See adjustment of envelope demodulator

Adjustment:

- Set measuring time of ESCS to 100 ms
- Set attenuator to 10-dB attenuation.
- Using R654 on the detector board (METER FULL SCALE) set the meter indication to ..... 50 ±0.5 dB
- Set attenuator to 60-dB attenuation.
- Using R631 on the detector board (METER ZERO 60 DB) set the voltage at the recorder output to ..... 0.5 V ± 50 mV
- Repeat the adjustment until the values are optimally set.
- Set the attenuator to 10-dB attenuation.

- Repeatedly switch the signal generator off and on and simultaneously set R652 (METER SPEED) on the detector board such that the pointer of the meter overshoots minimally on switch-on.

Adjusting the Total Gain

Test setup:

- Perform instrument cold start.

Instrument settings:

RF ATT:	20dB
Freq:	5.9MHz
Detector:	AV
IF Bw:	10kHz
CALGEN	100kHz ON

Measurement

- Adjustment in the range <1GHz using R300 on the IF SELECTION BOARD.
- Adjust the level display to 60dBuV using R300.
- Perform calibration.
- Call up the function IF Gain Adj in the service menu.
- Vary the level display according to ADJ VHF using R300.
- Perform calibration.
- Call up the function IF Gain Adj in the service menu.
  The values for 5.9 MHz MIN MAX and <1 GHz MIN MAX should now lie within the tolerance window.
  Tolerance for 5.9 MHz: ..... ±4 dB
  and for <1 GHz: ..... ±8 dB
  If this is not the case, vary R300 once again.
  Perform another calibration and check the new deviations using IF GAIN ADJ .
  Repeat this procedure until the values comply with the tolerances.
- Adjustment in the range >1GHz using R361 on the synthesizer and R10 on the frontend

  Instrument settings:

RF ATT:	10dB
Freq:	1100MHz
Detector:	AV
IF Bw:	10kHz
CALGEN	100kHz ON

- Perform calibration.
- Call the function IF Gain Adj in the service menu.
- Vary the level according to ADJ UHF using R361 and R10.
- Perform calibration.
- Call up the function IF Gain Adj in the service menu.
  The values for >1GHz MIN MAX should lie inside the tolerance window.
  Tolerance for >1GHz: ±8dB.
  If this is not the case, vary R361 or R10 again.
  Perform another calibration and check the new deviations using IF GAIN ADJ.
  Repeat this procedure until the values comply with the tolerances.

Note: *The tolerances indicated in the display are valid at room temperature only. At the limiting temperatures the following adjustment values apply:*

Frequency	Tolerance
5,9 MHz	±5,8 dB
< 1 GHz	±11 dB
> 1 GHz	±11 dB

Adjusting the Calibration Generator

Measuring equipment: Signal generator SMHU

Test setup:

➢ Connect signal generator calibrated to 60 dBµV ±0.1 dB to ESCS.

Settings on the ESCS:

Frequency	5.9 MHz
Detector	AV
IF BW	10 kHz
	Mode Low Noise
RF ATT	0 dB

Settings on signal generator:

Frequency	5.9 MHz
Level	60 dBµV

Measurement

➢ Perform calibration.

➢ Read off the level of the signal generator on the ESCS. If the nominal display 60 dBµV ±0.5 dB is not obtained, slightly vary R131 on the frontend and recalibrate until the nominal value is obtained. The level displayed is only updated after the calibration.

Note: *If the frequency response of the ESCS exceeds the tolerance limit in certain frequency ranges even after adjustment of the absolute level of the calibration generator, the internal calibration generator requires new measurement and storage of correction data.*

Adjusting the Reference Oscillator

Measuring equipment: Frequency counter, 10 MHz, error $<1x10^{-9}$

Test setup:

➢ Connect frequency counter to Ref IN/OUT rear-panel socket.

Settings on the ESCS: Reference int.

Measurement

➢ Measure frequency using frequency counter.

➢ Nominal frequency ..... 10 MHz ±10 Hz
with Option ESCS-B6 ..... 10 MHz ± 5 Hz

➢ If required, use the service function Ref Freq Adj to adjust the frequency to ..... 10.7 MHz ± 1 Hz

Complete Overview of all Points of Adjustment

Table 3-4

No.	Adjustment	Trimmer	Board
1	-10 V SUPPLY	R35	A1
2	DEMOD OFFSET	R520	A170
3	LOG GAIN	R529	A180
4	LOG REF	R524	A180
5	METER FULL SCALE	R654	A180
6	CAL GEN LEVEL	R131	A110
7	IF GAIN ADJ in the freq. range ≤1000 MHz	R300	A170
8	REF FREQ	Service function	A120
9	IF GAIN ADJ in the freq. range >1000 MHz	R361	A120
10	IF ANALYSIS, Gain Adjust	R293	A190
11	Tracking Generator, LEVEL ADJ	R24	A100

Removal and Replacement

Removing the Rear Panel

Removal of the rear panel is described in the service instructions for the REAR PANEL.

Removing the Front Panel

➢ Remove rotary knobs 1 and 2.

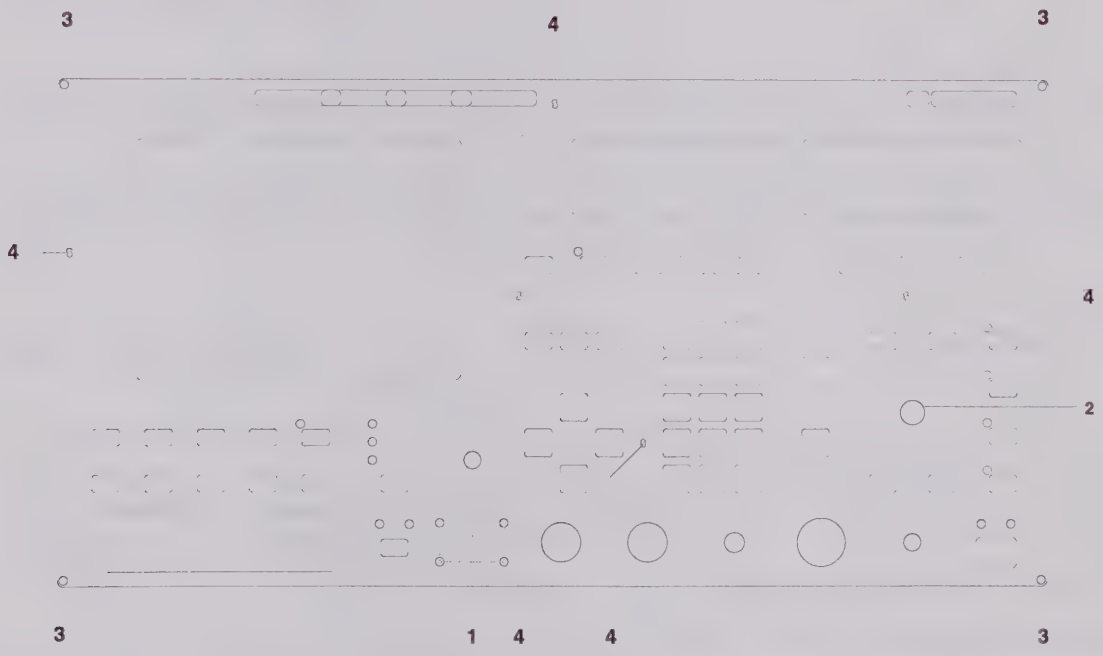


Fig. 3-8

➢ Remove front-panel screws 3 (4x) and 4 (5 x).

➢ Remove front panel.

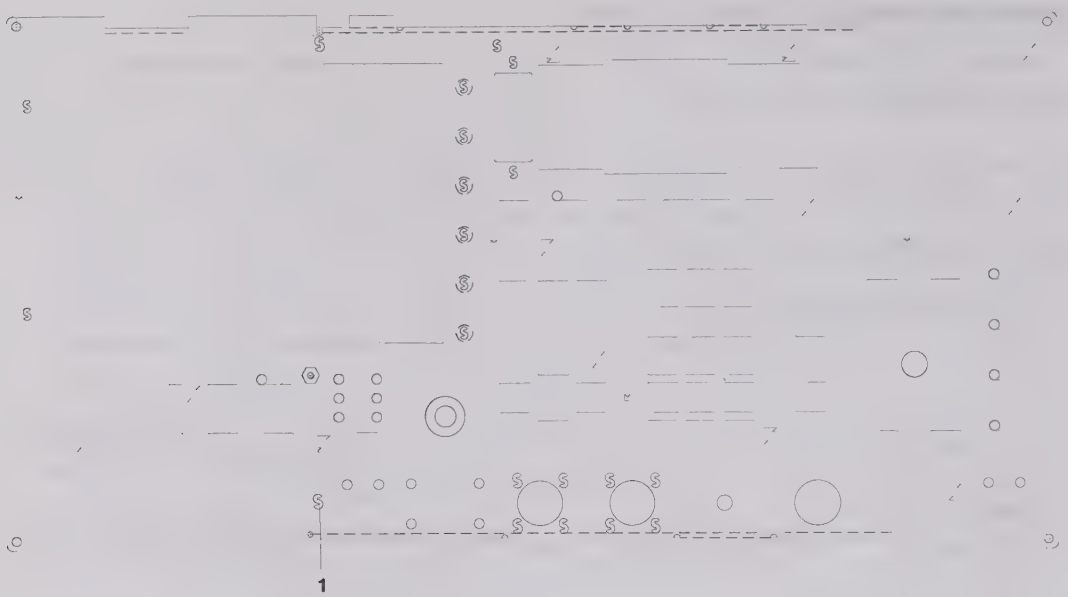


Fig. 3-9

➢ Loosen screw 1.

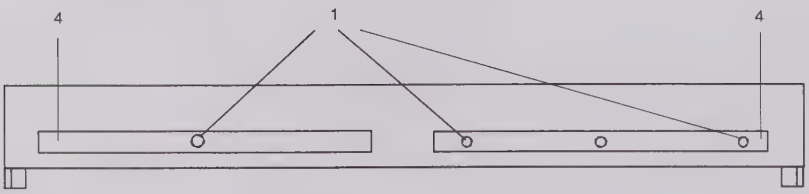


Fig. 3-10 Top view of instrument

➢ Remove covers 4.

➢ Remove screws 1

➢ Place the instrument upside down.

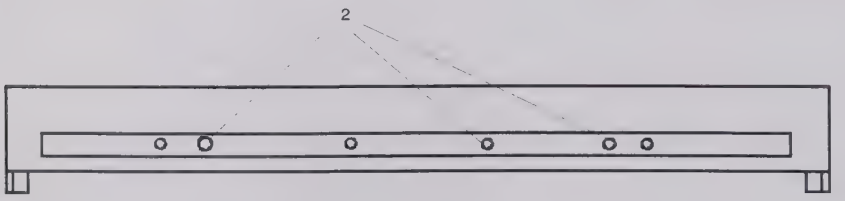


Fig. 3-11 Bottom view of instrument.

➢ Place the instrument onto the bottom side.

➢ Remove screws 2.

➢ Loosen flat cables W4, W50 at A30-X4 und A30-X5 and RF cable W1 at A110-X112.

➢ Loosen cable W104 at A41-X6.

➢ If the option ESCS-B5 (TACKING GENERATOR) is fitted, loosen RF cable W3 at A100-X100.

➢ Tilt the mounting panel forward.

4 Firmware-Update

The instrument firmware for test receivers ESHS, ESVS, ESVD and ESCS is stored in non-volatile FLASH memories, which can be erased and reprogrammed inside the instrument. To carry out a firmware update, it is thus no longer necessary to open the instrument in order to exchange the components. Loading is effected by means of the "FLASHUP.EXE" program from a personal computer (AT) via the serial RS232 interface.

Hardware Requirements

Firmware loading program FLASHUP.EXE can be executed on any personal computer conforming to industrial standard. The hardware must comprise a floppy disk drive ($3^1/_2$" or $5^1/_4$") as well as an RS232 interface. The use of a hard disk is recommended. No demands are made on the screen.

Each serial standard interface cable comprising a 25-pin male and a 9-pin female connector can be used to connect the test receiver to the PC, a complete wiring (cf. Fig. 4-1) being mandatory. Rohde & Schwarz offer a corresponding cable under order no. 816.1096.00 (included in service kit EZ-8)

Files for FLASHUP

The program package for transferring the firmware consists of the following files:

FLASHUP.EXE	main program
FLASHUPD.MSG	help texts (German)
FLASHUPD.NDX	index for German help texts
FLASHUPE.MSG	help texts (English)
FLASHUPE.NDX	index for English help texts

There are separate files for the different test receiver series ESXS10, ESXS30 and ESS in which the instrument firmware to be loaded is stored:

ESXS10.Hxx	for test receivers ESHS10 / ESVS10 / ESVD
ESXS30.Hxx	for ESHS / ESVS models 20 und 30
ESS.Hxx	for ESS
ESCS.Hxx	for ESCS

"xx" "xx" denotes a 2-digit number which is different for each firmware version.

A disk contains one of those files together with the FLASHUP program package and the release notes in which the changes and extensions of the respective firmware version are listed in brief.

Installation

Loading from the Floppy Disk Drive

➢ Insert floppy disk into drive A: or B:and call the program:

```
C:\>a:flashup
```

Loading from the Hard Disk

➢ Copy firmware loading program FLASHUP.EXE to a hard disk:
Making a separate subdirectory is recommended.

➢

➢ Insert the floppy disk containing the FLASHUP.EXE file or B: and start copying.

Example:
```
C:\>md flash
C:\>cd flash
C:\FLASH>copy a:*.* c:
```

A higher processing rate is achieved additionally if the firmware to be loaded (i.e. the ESCS.Hxx file) is also copied to the hard disk.

Starting the Firmware Loading Procedure

Using this alternative, the execution time for the loading procedure of the instrument firmware can be shortened substantially. First the complete contents of the floppy disk has to be copied to the hard disk. Making a separate subdirectory on the hard disk is recommended.

➢ Connect the PC to the test receiver by means of a cable.

➢ Switch off test receiver.

➢ Call FLASHUP program.

➢ Move the cursor between the different menu items by means of ← or → keys.

➢ Press ENTER key.
The function selected is executed or a parameter set..

➢ Select the menu items using ↑ or ↓ keys.

➢ Press ENTER key.
The function selected is executed or a parameter set.

The menu bar is reached or a current process aborted using the ESC key.

Help texts: A brief explanation about the contents of each function is given in the bottom line of the screen. Detailed help texts are available using the function key [F1]. The window opened can be closed again using the ESC key.

Error messages: The FLASHUP program supervises the firmware loading process which is protected by a defined protocol and by a check sum procedure. Whenever an error occurs during the transfer, the user is informed about the problem in a special window. As far as possible, the program gives hints on how to solve the problem.

Initialization

- Select the firmware file to be loaded using menu item File Select HEX-File
- Press ENTER.
- The name of the file which was loaded last (if there is any) is displayed. If no file has been loaded, a selection list can be set up by simultaneously pressing the CTRL (or Strg) and ENTER keys. The drive can be changed by pressing the [F3] function key. This is necessary if the firmware is to be loaded from the floppy disk.
- Select the file using the cursor keys and confirm using ENTER
- Select the serial interface at the PC to which the cable is connected (COM1 to COM4) and set the baud rate. The other RS232 parameters (word length, start/stop bit, etc.) are fixedly set.

The language for outputting help texts and error messages can be chosen between German and English.

The extensions and changes the firmware version contains are displayed under menu item Info - Release Notes (German or English).

Note: *All program parameters (set baud rate, HEX-file loaded, etc.) are saved in the FLASHUP.INI file and stored anew when exiting the program using QUIT.*

- Starting the loading procedure:
  - Select menu item Execute using the cursor keys.
  - The firmware loading procedure is started by pressing the ENTER key twice.
  - Switch on test receiver.
    The loading procedure runs automatically, the run is displayed by a bar display on the PC screen. The program signals the end of the transfer, the receiver automatically starts in its normal operating mode. The loading procedure can be aborted using the ESC key.

Note: *The loading procedure runs automatically, the run is displayed by a bar display on the PC screen. The program signals the end of the transfer, the receiver automatically starts in its normal operating mode. The loading procedure can be aborted using the ESC key.*

Exiting the program:

Exit firmware loading program FLASHUP by selecting menu item QUIT and pressing the ENTER keys.

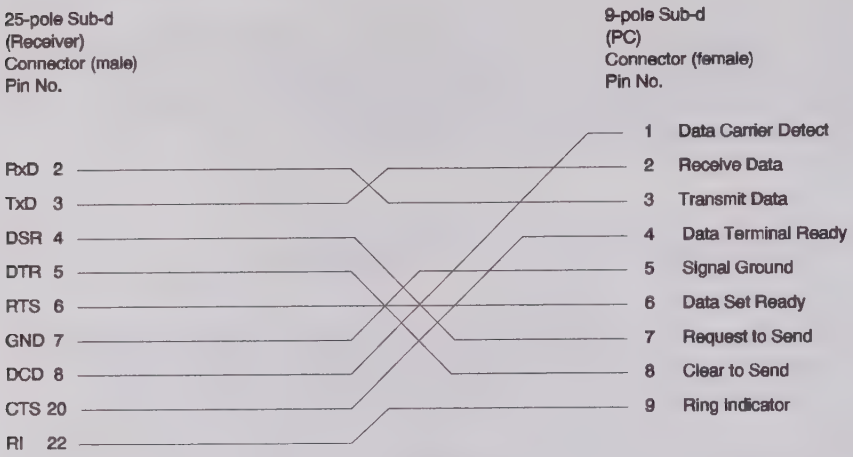


Fig. 4-1 Adapter cable for serial interface

ROHDE&SCHWARZ

Liste mechanischer Teile

Bilder und Erklärung zur Liste mechanischer Teile

List of mechanical parts

Figures and explanation pertaining to list of mechanical parts

Liste des pièces mécaniques

Figures et définitions pour liste des pièces mécaniques

(R 48 010 - 1)
095.1000 Bl. 13

Liste mechanischer Teile

Der ESCS ist in ***R&S-Kompaktbauweise 90*** aufgebaut.

Gehäusegröße:
5E, 1/1, T350

Maße über alles:
435,5 × 292,5 × 382,0 (B × H × T)

Ergänzungen:
19"-Adapter ZZA

Tragegriff, Nachrüstsatz
(falls ein zweiter Tragegriff gewünscht wird)

List of mechanical parts

The ESCS is designed in accordance with the ***R&S design 90***.

Cabinet size:
5E, 1/1, T 350

Overall dimensions:
435,5 × 292,5 × 382,0 (width × height × depth)

Accessories:
19"-Adapter ZZA

Carrying handle, retrofit set
(if a second carrying handle is desired)

Lfd. Nr.	Kenn-zeichen	Menge	Benennung/Beschreibung	Sachnummer
No	Unit/ Comp.No	Qty	Designation	Stock No.
1	MZ	1	Haube, oben 5E, 1/1, T350 Cover, top	845.2139
2	MZ	1	Haube, unten 5E, 1/1, T350 Cover, bottom	845.2145
8	MF	2	Gerätefuß, vorne Instrument foot, front	396.4534
9	MF	2	Aufstellfuß, unten Foot, bottom	396.4540
11	ZM	2	Gerätefuß, hinten Instrument foot, rear	396.4586
15	MF	2	Seitenleiste T350 Side strip	396.3073
16	VS	4	M3x6 DIN965 A4	081.9378
17	ZM	1	Rückwandfuß, links 5E Rear-panel foot, left	396.4392
18	ZM	1	Rückwandfuß, rechts 5E Rear-panel foot, right	396.4186
19	VS	4	Ansatzschr. M4 K. D7985 Screw	396.4492
21	ZM	2	Tragegriff T350 Carrying handle	396.3215

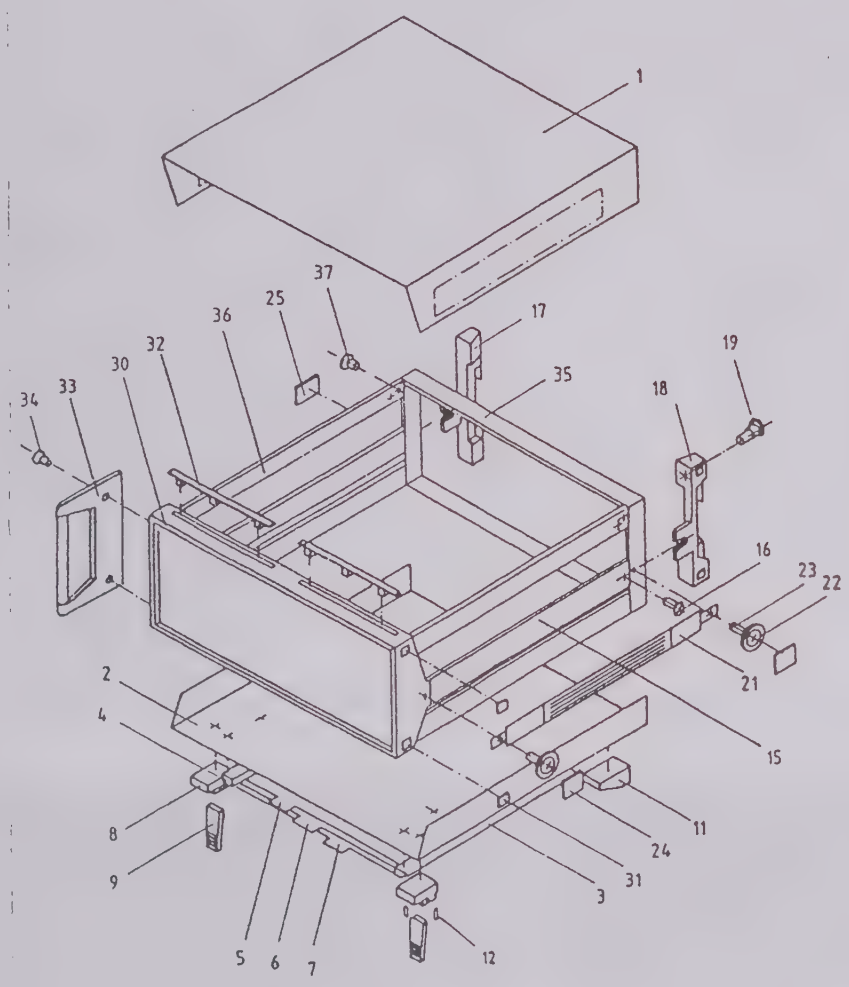
Lfd. Nr.	Kenn-zeichen	Menge	Benennung/Beschreibung	Sachnummer
No	Unit/ Comp.No	Qty	Designation	Stock No.
22	MR	4	Griffbuchse Washer	396.3367
23	VS	4	M4 x 10 DIN965 A4	081.9478
24	MF	4	Abdeckung, Griffseite Cover, handle side	396.3350
30	ZM	1	Frontrahmen 5E 1/1 Front frame	396.2154
31	WT	4	Seitenfuß Side foot	396.4692
32	WT	2	Stapelnutabdeckung Cover for groove	396.4711
35		1	Rückrahmen 5E 1/1 Rear frame	396.2290
36		4	Rahmenschiene T350 Frame rail	396.2360
37	VS	16	M3 x 8 DIN965 A4	081.9384
40	WG	3,43M	HF-Dichtschnur O-Prof. 2,0 SI RF seal	396.1035
41	WG	1,24 M	HF-Dicht. O-Prof. 2,7 SI RF seal	396.0916

Gehäuse

Aufbau

Der Aufbau besteht aus einer tragenden Aluminium-Druckguß-Rahmenkonstruktion mit gerätespezifischer Front-, Montage- und Rückplatte, die mit einer Ober- und Unterhaube (= Beplankung) ummantelt ist.

Rahmen und Beplankung:



Casing

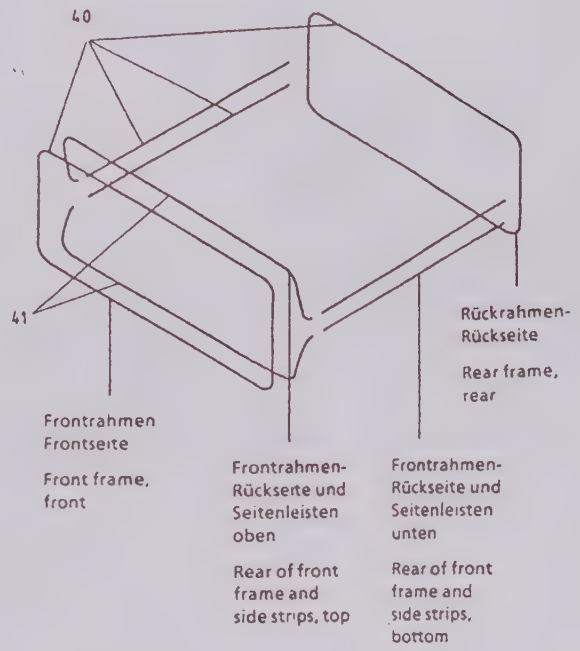
Construction

The construction consists of a self-supporting aluminium-cast frame with front, mounting and rear panel, top and bottom covers (= panelling).

Frame and panelling:

Dichtschnur (nur bei Geräten mit erhöhtem Schirmdämpfungsbedarf vorhanden) jeweils in die umlaufende Nut einlegen.

Insert the braided cord (provided only for instruments requiring a high degree of shielding) into the respective groove.



Die Dichtschnüre in der Frontrahmen-Frontseite und in der Rückrahmen-Rückseite müssen durch Klebepunkte in Abständen von ca. 80 mm fixiert werden. Dazu Klebepunkte mit ca. ø2 mm im Nutgrund anbringen und Dichtschnur aufdrücken.
Dauerhaft elastischen Kleber wie z.B. Si-Kautschuk 3145 RTV (R&S-Sachnr. WV 088.3152) verwenden.

Bei Geräten mit geteilten Rückplatten müssen beim Zusammenbau die Einzelelemente über die gesamte Gehäusebreite waagerecht zueinander ausgerichtet werden.
Ober- und Unterhaube müssen mit den Erhöhungen am Rückrahmen fixiert sein.

Achtung: bei hohen Rückwandfüßen (CMS) werden die Fixier-Erhöhungen verdeckt, hier Rückwandfüße erst anschrauben, wenn die Ober- u. Unterkante sicher in den Erhöhungen am Rückrahmen fixiert sind.

The braided cords in the front of front frame and rear of rear frame must be fixed by glued joints approx. every 80 mm. Make joints (ø approx. 2 mm) on the bottom of the groove and press braided cord firmly on it.

Use a permanently elastic adhesive, such as Si-rubber 3145 RTV (R&S Part No. WV 088.3152).

Instruments with separate rear panels require the individual components to be adjusted to the same level over the complete instrument width.
Top and bottom cover must be fastened by way of the catches on rear frame.

Note that with high rear panel feet (CMS) the catches are concealed; here tighten the rear feet screws only after the top and bottom cover have been securely fitted into the catches.

Öffnen und Schließen des Gehäuses

Die gute Schirmdämpfung der Kompaktbauweise 90 erfordert häufige Kontaktstellen und hohe Paßgenauigkeit. In Verbindung mit einem leichten Anlagedruck, der mit dem Festziehen der Rückwandfußschrauben erreicht wird, erhält man einen straffen Sitz der Ober- und Unterhaube auf dem Rahmen.

Zum *Öffnen* muß man die Rückwandfußverschraubung lösen und die Füße nach rückwärts abziehen (Schrauben bleiben im Fuß haften). Je nach Bedarf läßt sich nun Ober- bzw. Unterhaube ebenfalls nach rückwärts abnehmen. Sitzen die Hauben sehr fest, erleichtert man das Abziehen durch abwechselndes Hebeln in Pfeilrichtung mit einem Schraubenzieher an beiden Geräteseiten (siehe Bild).

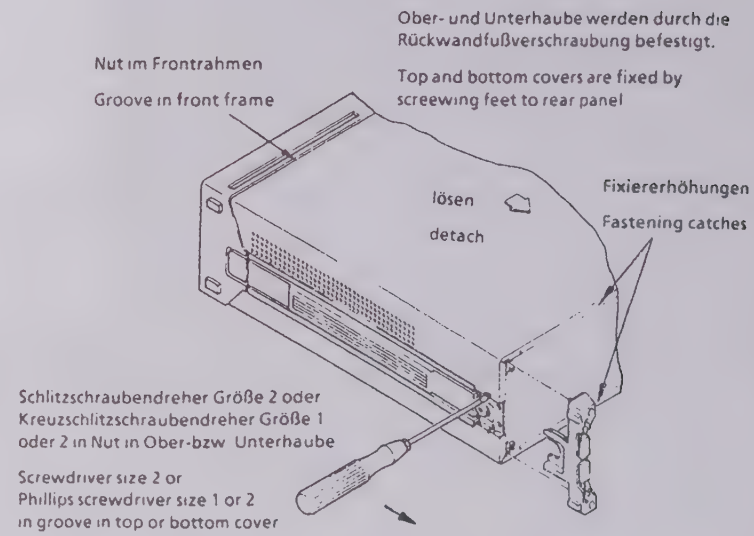
Zum *Schließen* des Gehäuses werden erst die Frontkanten der Hauben in die umlaufende Nut des Frontrahmens und der Seitenleisten eingeführt und dann in die Erhöhungen am Rückrahmen bis Anschlag eingerastet. Das Gerät ist wieder geschlossen, wenn die Rückwandfüße eingeschoben und die Schrauben festgezogen sind.

Opening and closing the cabinet

To obtain the high degree of shielding of design 90, many points of contact and accurate fitting are employed. When exerting a slight pressure by tightening the rear-panel feet, tight fitting of the top and bottom covers is ensured.

To *open* the cabinet, first undo the rear panel feet screws and withdraw the feet (captive screws). It is now possible to detach top and bottom cover if required. If the fitting of these cover plates is very tight, removal can be facilitated by alternately levering on both sides of the instrument using a screwdriver (see illustration).

To *close* the cabinet, insert the front edges of the covers into the groove of the front frame and the side strips and lock them into the catches on the rear frame into detent position. The cabinet is closed when the rear-panel feet are inserted and the screws tightened.


Ober- und Unterhaube werden durch die Rückwandfußverschraubung befestigt.
Top and bottom covers are fixed by screewing feet to rear panel
Nut im Frontrahmen
Groove in front frame
lösen
detach
Fixiererhöhungen
Fastening catches
Schlitzschraubendreher Größe 2 oder Kreuzschlitzschraubendreher Größe 1 oder 2 in Nut in Ober-bzw Unterhaube
Screwdriver size 2 or Phillips screwdriver size 1 or 2 in groove in top or bottom cover

STROMLAUF GILT FUER VAR.30

CIRCUIT DIAGRAM IS VALID FOR MOD.30

FUER DIESE UNTERLAGE BEHALTEN WIR UNS ALLE RECHTE VOR

1082.8007.01 S

RF INPUT
HF – EINGANG
9 kHz ...2750 MHz

X1 — W1 — X112

ATTENUATOR

MESURE/CAL

IMPULSFEST

2x5 DB | 10 DB | 20 DB | 20 DB

CAL GEN

C/D
100 kHz
PULSE

A/B
100kHz/
100Hz/
25Hz
PULSE

100kHz

TO MOTHERBOARD

A110

9 kHz...8 MHz

SPLITTER
DC...2.75 GHz

8MHz..1GHz

1...2 GHz

PRESELECTOR

RELAIS

RELAIS

150 KHZ

150 KHZ...2 MHZ

2 MHZ ...8 MHZ

8 MHZ..25 MHZ

25 MHZ...80 MHZ

80 MHZ... 200 MHZ

200 MHZ... 500 MHZ

500 MHZ... 1 GHZ

1 GHz... 1.9 GHz

1.9 GHz...2.75 GHz

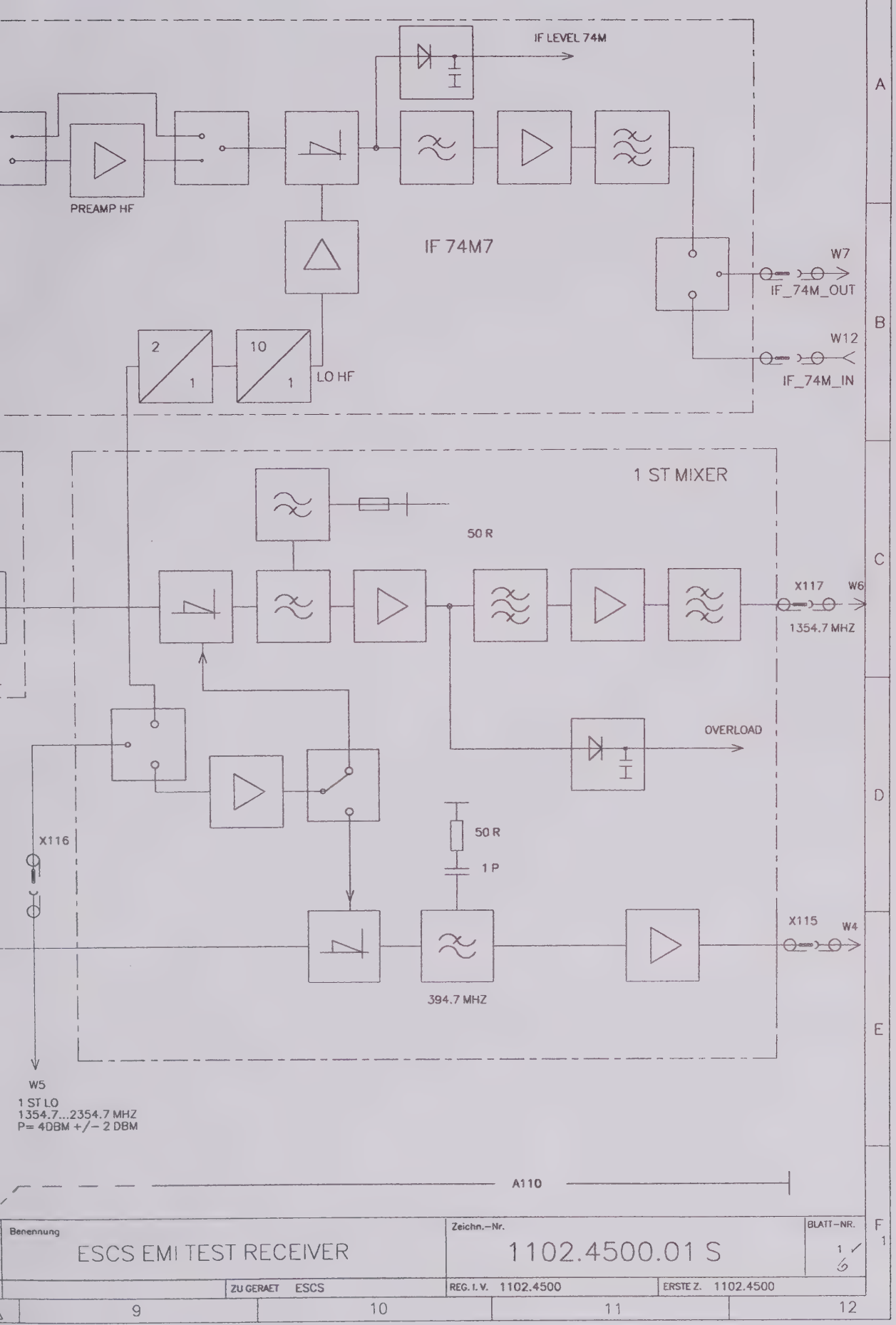
PREAMP

PREAMP VHF

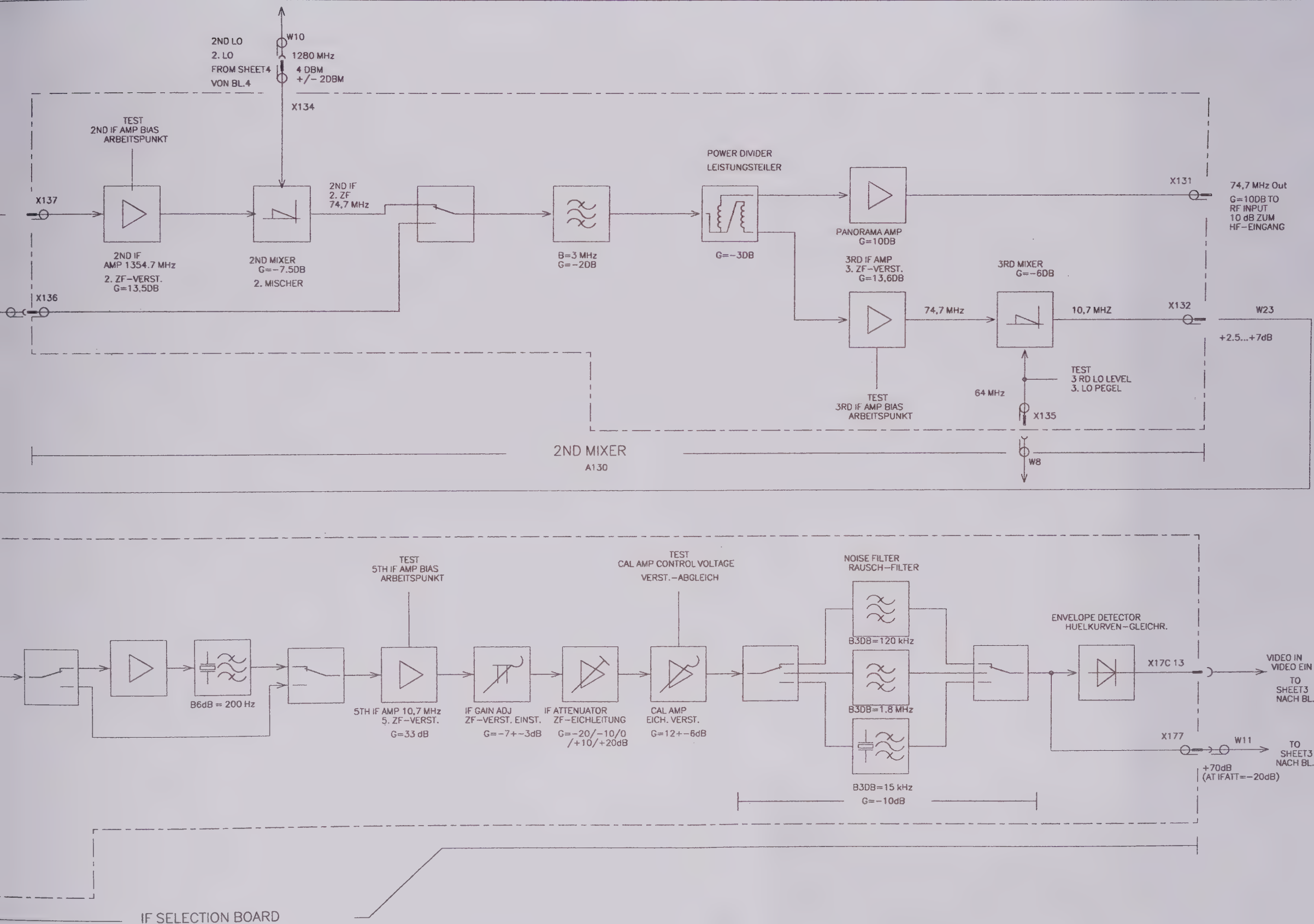
PIN

01.00		02.97	SO					1ESK	Datum	Name
01.01		06.97	Pf					Bearb.		SO
								Gepr.		
Aend. Zust.	Aenderunsmitteilung	Datum	Name	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Norm		

ROHDE&SCHWARZ



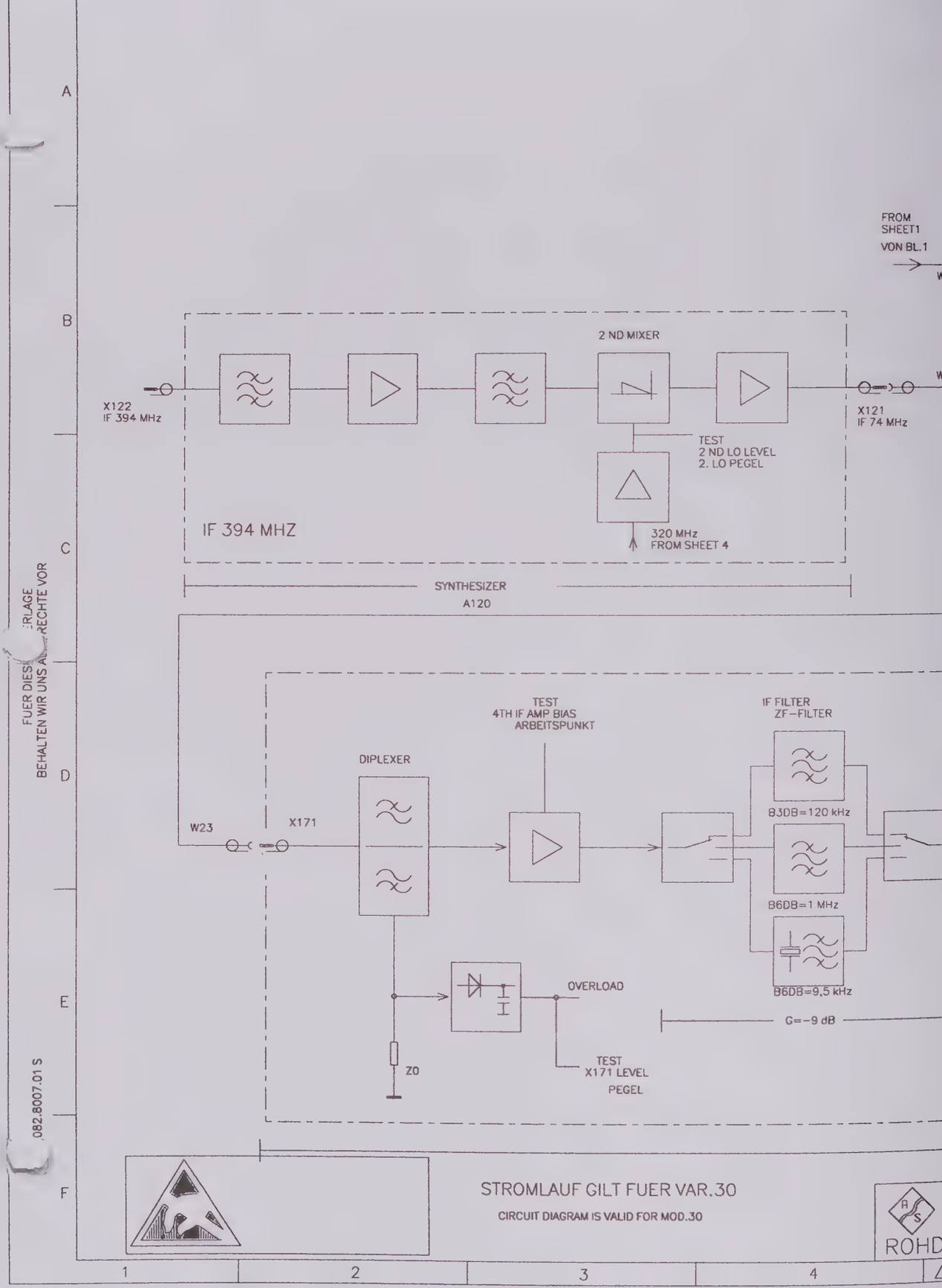
Benennung	Zeichn.-Nr.	BLATT-NR.
ESCS EMI TEST RECEIVER	1102.4500.01 S	1 / 6
ZU GERAET ESCS	REG. I. V. 1102.4500	ERSTE Z. 1102.4500



	01.00		02.97	SO					1ESK	Datum	Name	Benennung	ESCS EMI TEST RECEIVER	Zeichn.-Nr.	1102.4500.01 S	BLATT-NR. 2✓ 6
	01.01		06.97	Pf					Bearb.		SO					
&SCHWARZ	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Gepr.							
									Norm				ZU GERAET ESCS	REG. I. V. 1102.4500	ERSTE Z. 1102.4500	

5 | 6 | 7 | 8 | △ | 9 | 10 | 11 | 12

A | B | C | D | E | F 2


FROM
SHEET1
VON BL.1
2 ND MIXER
X122
IF 394 MHz
X121
IF 74 MHz
TEST
2 ND LO LEVEL
2. LO PEGEL
IF 394 MHZ
320 MHz
FROM SHEET 4
SYNTHESIZER
A120
TEST
4TH IF AMP BIAS
ARBEITSPUNKT
IF FILTER
ZF-FILTER
DIPLEXER
W23
X171
B3DB=120 kHz
B6DB=1 MHz
B6DB=9,5 kHz
OVERLOAD
G=-9 dB
Z0
TEST
X171 LEVEL
PEGEL
STROMLAUF GILT FUER VAR.30
CIRCUIT DIAGRAM IS VALID FOR MOD.30
ROHD
A
B
C
D
E
F
1
2
3
4

FUER DIESE UNTERLAGE
BEHALTEN WIR UNS ALLE RECHTE VOR

TEST

BUFFER
TRENNSTUFE

X183

TRANSDUCER
CORRECTION BY DAC

TRANSDUCERKORREKTUR UEBER
D/A-WANDLER

TEST

AV DETECTOR
MITTELWERT-TIEFPASS

τ=100US,1MS,10MS,100MS

30/60dB

TEST
LOG AMP

BUFFER
TRENNSTUFE

VIDEO IN
VIDEO EIN

FROM SHEET2
VON BL.2

X18A 13

10,7 MHz

QP DETECTOR

SIMULATION
OF METER RESPONSE
INSTRUMENT-
NACHBILDUNG

TEST

30DB: G=20dB
60DB: G=dDB

LOG AMP
LOG. VERST.

TEST
LOG AMP

BUFFER
TRENNSTUFE

X18C 15

1...4.6V

PK DETECTOR

RESET
PK-ENTLADUNG

WIDE/NARROW
BREIT/SCHMAL

F3

FROM
SHEET2
VON BL.2

W11

X187

BUFFER AMP
TRENN-VERST.

A3
A0

AF GAIN
LAUTSTAERKE

AF AMP
NF-VERST.

X18C 12
100 KHz

PLL

10,7 MHz
(A0)

DETECTOR BOARD

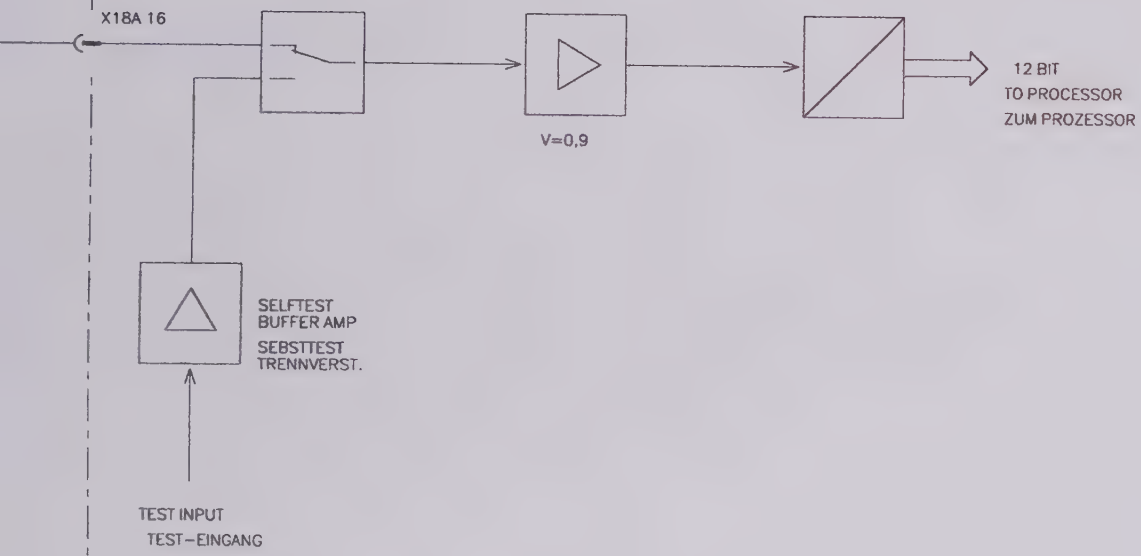
A180

ROHDE&SCHWARZ

Aend. Zust.	Aenderunsmitteilung	Datum	Name	Aend. Zust.	Aenderunsmitteilung	Datum	Name		Datum	Name
01.00		02.97	SO					1ESK		
01.01		06.97	Pf					Bearb.		SO
								Gepr.		
								Norm		

METER

ECORDER OUTPUT
(USER PORT)
0...5V



CPU BOARD

A220

STROMLAUF GILT FUER VAR.30

CIRCUIT DIAGRAM IS VALID FOR MOD.30

Benennung	Zeichn.-Nr.	BLATT-NR.
ESCS EMI TEST RECEIVER	1102.4500.01 S	3 ✓ 6
ZU GERAET ESCS	REG. I.V. 1102.4500	ERSTE Z. 1102.4500

9 10 11 12

A B C D E F

3

PD

X300

TEST
REF. LOOP
ABSTIMMSP.

64 MHZ VCXO

X110

REFERENCE DIVIDER

2 / 1

2 / 1

16 MHz

16 / 1

1 MHz

10 / 1

X120
A12
100KHz

REF 1 MHz

32 MHz

TEST
X126 LEVEL
PEGEL

X126
LO 3

64 MHz OUTPUT AMPLIFIER

TEST
X125 LEVEL
PEGEL

W8

X125
64MHz

X100

REF64 MHZ

X123
1280 MHz
5 DBM

W10

320 MHZ

SHEET2

10 / 1

FRACSYN2

CKI

DIVIDER

VCO 1,35...2,35 GHz

4 / 1

N / 1

16 MHz

PHASE DETECTOR

PD

LOOP FILTER

X2

TEST
1 ST LO LOOP
ABSTIMMSP.

TEST
X127 LEVEL
LO PEGEL

OUTPUT AMPLIFIER

W5

X127
LO1

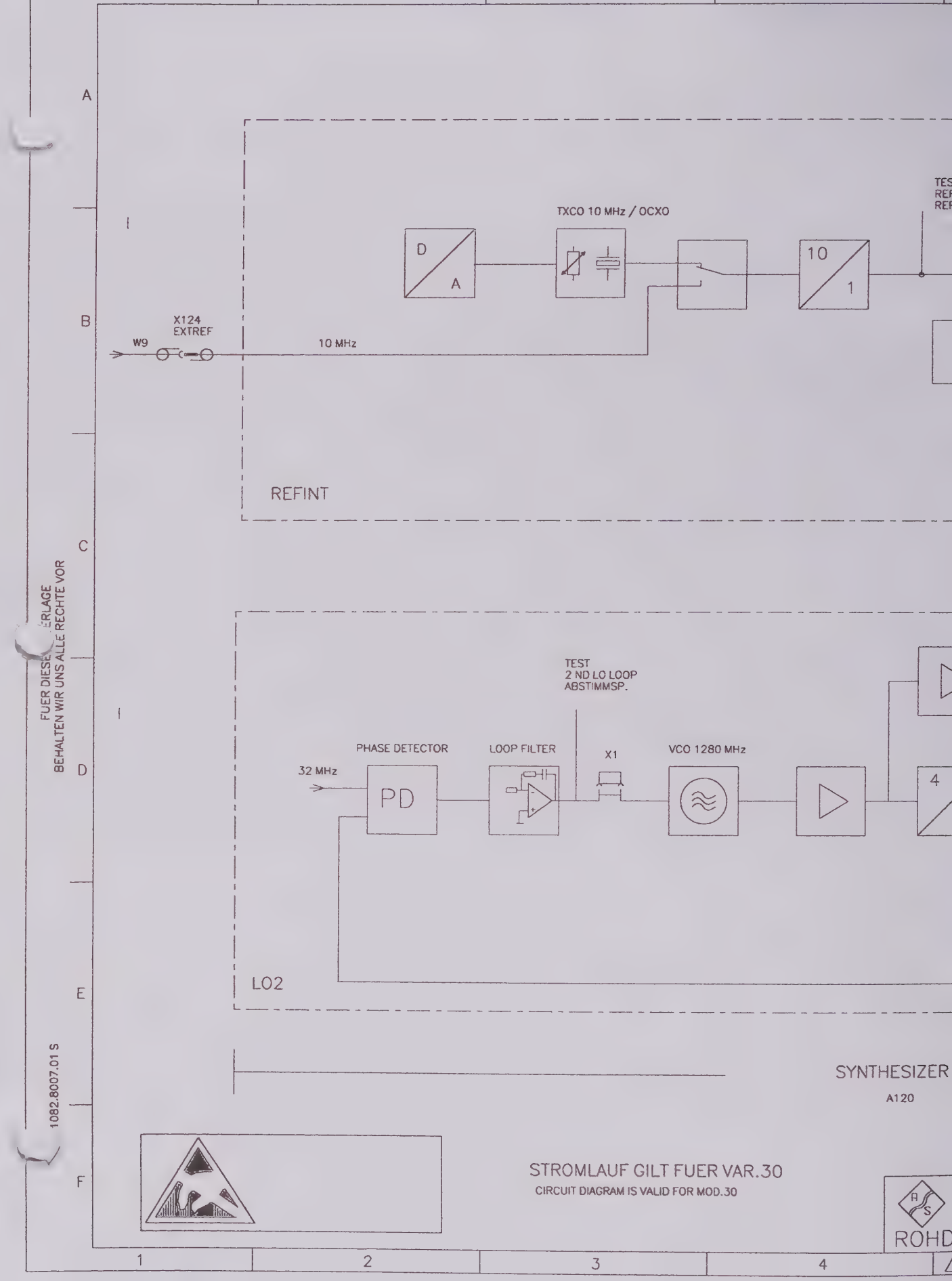
FRN

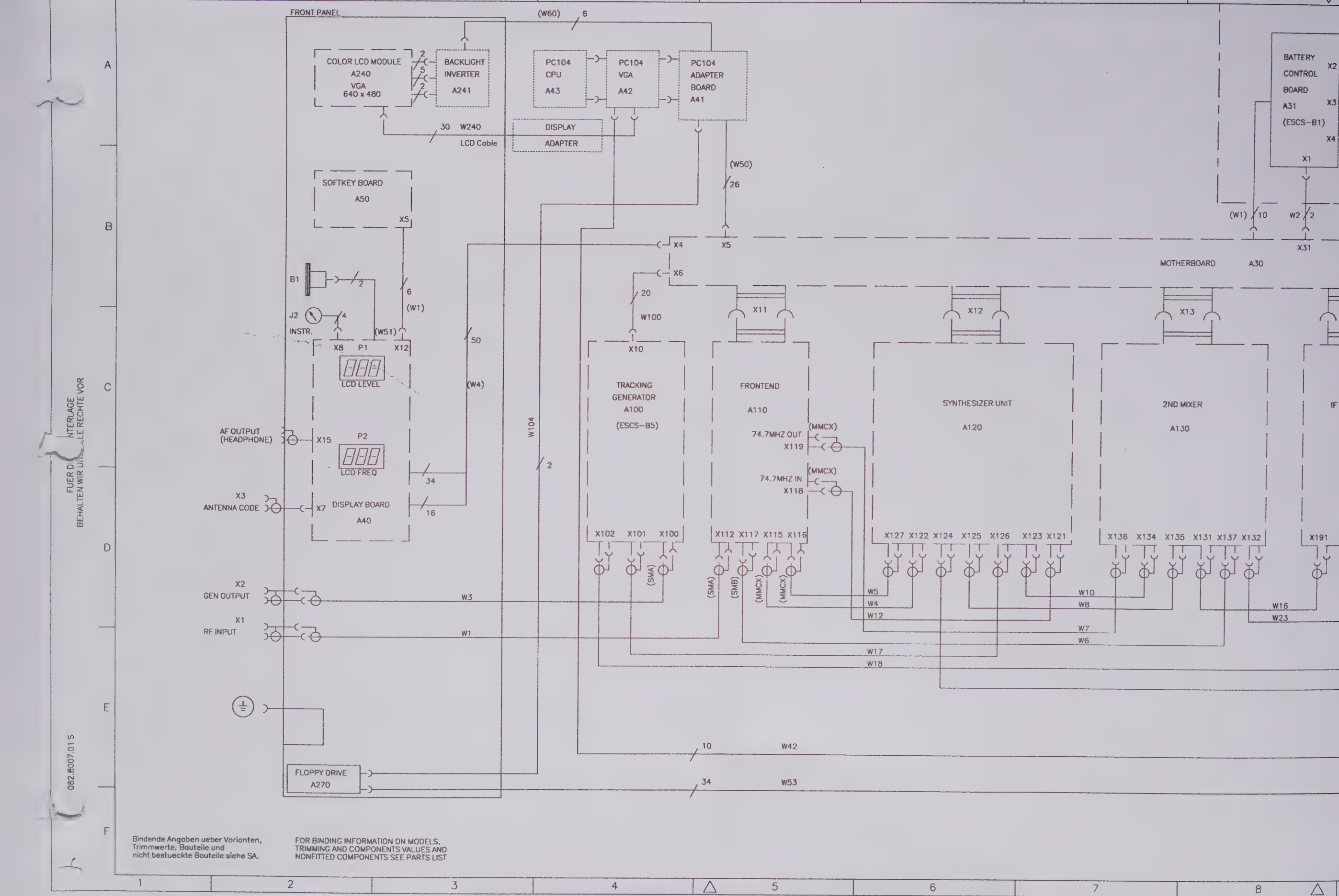
	01.00		02.97	SO					1ESK	Datum	Name	Benennung ESCS EMI TEST RECEIVER	Zeichn.-Nr. 1102.4500.01 S	BLATT-NR. 4 ✓ 6
	01.01		06.97	Pf					Beorb.		SO			
&SCHWARZ	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Gepr. Norm			ZU GERAET ESCS	REG. I. V. 1102.4500	ERSTE Z. 1102.4500

5 6 7 8 △ 9 10 11 12

A B C D E F 4

FUER DIESE ZEICHNUNG BEHALTEN WIR UNS ALLE RECHTE VOR
ÜBERLAGE




FRONT PANEL
(W60) 6
COLOR LCD MODULE
A240
VGA
640 x 480
2
5
2
BACKLIGHT
INVERTER
A241
PC104
CPU
A43
PC104
VGA
A42
PC104
ADAPTER
BOARD
A41
30 W240
LCD Cable
DISPLAY
ADAPTER
(W50)
26
SOFTKEY BOARD
A50
X5
B1
2
6
(W1)
J2
4
INSTR.
(W51)
X8 P1 X12
LCD LEVEL
50
(W4)
W104
2
AF OUTPUT
(HEADPHONE)
X15
P2
LCD FREQ
34
X3
ANTENNA CODE
X7
DISPLAY BOARD
A40
16
X4
X5
X6
20
W100
X10
TRACKING
GENERATOR
A100
(ESCS-B5)
X11
FRONTEND
A110
(MMCX)
74.7MHZ OUT
X119
(MMCX)
74.7MHZ IN
X118
X12
SYNTHESIZER UNIT
A120
X13
2ND MIXER
A130
BATTERY
CONTROL
BOARD
A31
(ESCS-B1)
X2
X3
X4
X1
(W1) 10
W2 2
X31
MOTHERBOARD A30
X102 X101 X100
X112 X117 X115 X116
X127 X122 X124 X125 X126 X123 X121
X136 X134 X135 X131 X137 X132
X191
(SMA)
(SMA)
(SMB)
(MMCX)
(MMCX)
W5
W4
W12
W10
W8
W7
W6
W16
W23
W17
W18
X2
GEN OUTPUT
W3
X1
RF INPUT
W1
10
W42
34
W53
FLOPPY DRIVE
A270
FUER DIESE UNTERLAGE
BEHALTEN WIR UNS ALLE RECHTE VOR
082.E007.01 S
Bindende Angaben ueber Varianten,
Trimmwerte, Bauteile und
nicht bestueckte Bauteile siehe SA.
FOR BINDING INFORMATION ON MODELS,
TRIMMING AND COMPONENTS VALUES AND
NONFITTED COMPONENTS SEE PARTS LIST

G1 (ESCS-B2)
G2 (ESCS-B2)
G3 (ESCS-B2)
3
3

POWER SUPPLY SECTION

X31 SUPPLY VOLTAGE
F1
100/120V:
IEC127 T2.5L/250V
230/240V:
IEC127 T1.5L/250V

X32 BATT. 11...33V
F2
IEC127 T10 L/250V

H1 SUPPLY OK

X3 W43 10 X13
X2 W44 20 X12
6 X35 KEYBOARD

X17 X18 X22

YSIS

IF SELECTION BOARD
A170

DETECTOR BOARD 2
A180

CPU BOARD
A220

REAR PANEL
A1

X195 X171 X176 X174 X177 X187 X183 X223 X221 X222
W11

15
W45 40 25 X36 PRINTER INTERFACE
X37 USER INTERFACE
W46 26 X38 IEC 625

W13 X41 10,7 MHZ OUT
W9 X44 REF IN/OUT
W15 X43
W42 X50 VGA

ROHDE&SCHWARZ	01.00		02.97	SO					1ESK	Datum	Name	Benennung ESCS EMI TEST RECEIVER	Zeichn.-Nr. 1102.4500.01 S	BLATT-NR. 5/6
	01.01		06.97	Pf					Bearb.	02.97	SO			
	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Aend. Zust.	Aenderunsmitteilung	Datum	Name	Norm			1	ZU GERAET ESCS	REG. I. V. 1102.4500	ERSTE Z. 1102.4500

9 10 △ 11 12 13△ 14 15 16

A B C D E F

X37 USER INTERFACE

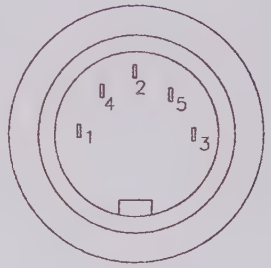
PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	EXTRIG	14	UP1
2	RXD	15	UP2
3	TXD	16	UP3
4	DSR	17	UP4
5	DTR	18	UP5
6	RTS	19	UP6
7	AGND	20	CTS
8	DCD	21	STBRP*
9	SCLKRP	22	RI
10	TDATARP	23	REC1
11	REC2	24	AGND
12	DGND	25	+12V
13	+5V		

X36 PRINTER INTERFACE

PIN NO.	SIGNAL
1	PRISTB*
2	PRIDAT2
3	PRIDAT5
4	PRIACK*
5	PRISEL
6	PRIDAT0
7	PRIDAT3
8	PRIDAT6
9	PRIBUSY
10	PRIRES*
11	PRIDAT1
12	PRIDAT4
13	PRIDAT7
14	AGND
15	PRIFAU*

X35 EXT. KEYBOARD

PIN NO.	SIGNAL
1	KEY.CLK
2	EXT.KEYB.
3	UNUSED
4	GNDD
5	+5VD



X3 ANTENNA CODE

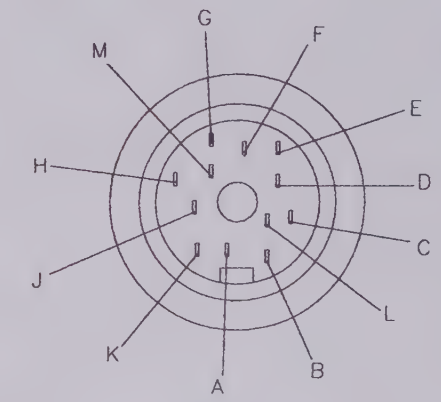
PIN NO.	SIGNAL
A	GND
B	+10V
C	UV/M
D	UA
E	10DB
F	20DB
G	40DB
H	80DB
J	FREQ 1
K	−10V
L	FREQ 2
M	VZ

X38 IEC625

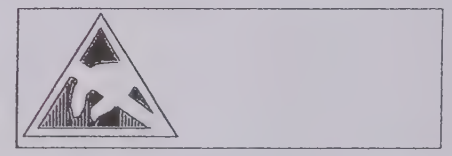
PIN NO.	SIGNAL	PIN NO.	SIGNAL
1	IECD1	13	IECD5
2	IECD2	14	IECD6
3	IECD3	15	IECD7
4	IECD4	16	IECD8
5	EOI	17	REN
6	DAV	18	AGND
7	NRFD	19	AGND
8	NDAC	20	AGND
9	IFC	21	AGND
10	SRQ	22	AGND
11	ATN	23	AGND
12	AGND	24	AGND

X32 EXT. BATT

PIN NO.	SIGNAL
1	−
2	+
3	UNUSED



STROMLAUF GILT FUER VAR.30
CIRCUIT DIAGRAM IS VALID FOR MOD.30



FUER DIESE UNTERLAGE
BEHALTEN WIR UNS ALLE RECHTE VOR

1011.2006.01 S

01.00		02.97	SO					1ESK	Datum	Name	Benennung ESCS EMI TEST RECEIVER	Zeichn.-Nr. 1102.4500.01 S	BLATT-NR. 6 — 6
01.01		06.97	Pf					Bearb.		SO			
								Gepr.					
Aend. Zust.	Aenderungsmitteilung	Datum	Name	Aend. Zust.	Aenderungsmitteilung	Datum	Name	Norm			ZU GERAET ESCS	REG. I. V. 1102.4500	ERSTE Z. 1102.4500

ROHDE&SCHWARZ

1 2 △ 3 4 △ 5 6 7 8

ROHDE&SCHWARZ

Schaltteillisten
Stromläufe
Bestückungspläne

Part lists
Circuit diagrams
Components plans

Listes des pièces détachées
Schémas de Circuit
Plans des composants

(R 29500 Bl. 2)
095.1000 Bl. 2

ROHDE&SCHWARZ

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(R 29500 Bl. 2)
095.1000 Bl. 2

Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX ZUGEH.STROML. CIRC.DIAGR. 1102.4500.01 S				
A1	ZJ REAR PANEL REAR PANEL	1002.9753.10			
A30	ED MOTHERBOARD MOTHERBOARD	1102.4698.02			
A31	ED BATTERIE_CNTR_BOARD BATTERY CONTROLLER BOARD NUR VAR/ONLY MOD: 12	1102.5994.02			
A40	ED DISPLAYBOARD DISPLAYBOARD	1102.5394.02			1102.4746.01
A41	ED PC104 ADAPTERBOARD PC104 ADAPTERBOARD IM NUTZEN DES DISPLAY- BOARDS ENTHALTEN	1102.5442.02			1102.4746.01
A42	GM VGA-G.BOARD PC/104 DISPLAY CTRL BOARD	1102.5642.00	JUMP_COMPU	PC/104-SPRINT-5	1102.4746.01
A43	ZE PC/104-RECHNER PROGRA. PC/104-COMPUTER PROGRAM.	1102.5459.02			1102.4746.01
A50	ED SOFTKEY BOARD SOFTKEY BOORD	1102.5165.02			1102.4746.01
A110	EE FRONT END FRONT END	1102.5242.02			
A120	ZE SYNTHESIZER UNIT SYNTHESIZER UNIT NUR VAR/ONLY MOD: 30	1082.8620.02			
A120	ZE SYNTHESIZER UNIT SYNTHESIZER NUR VAR/ONLY MOD: 12	1082.8620.03			
A130	EE 2ND MIXER 2ND MIXER	1010.9094.07			
A170	EE IF SELECTION BOARD IF SELECTION BOARD NUR VAR/ONLY MOD: 12	1010.9820.16			
A170	EE IF SELECTION BOARD IF SELECTION BOARD NUR VAR/ONLY MOD: 30	1010.9820.13			
A180	EE DETECTOR BOARD 2 NUR VAR/ONLY MOD: 12	1010.8498.09			
A180	EE DEDEKTOR BOARD 2 DETECTOR BOARD 2 NUR VAR/ONLY MOD: 30	1010.8498.10			
A220	EE CPU BOARD CPU BOARD	1003.7331.02			
A240	BP TFT 640X3X480 FARB-LCD COLOR LCD MODULE	1102.5636.00	NEC	NL6448AC20-6	1102.4746.01
A270	GM 3,5"FLOPPY DISK DRIVE FLOPPY DRIVE 3.5"	0048.4935.00	TEAC	FD 235 HF 8291	
B1	EL LAUTSPRECHER 0,5W150HM LOUDSPEAKER	0243.1298.00	SELTECH	AD2071/Z-15	
G1	EB BATTERIEPACK 13,2V 6AH BATTERY PACK NUR VAR/ONLY MOD: 12	1102.5607.00	BATTIV	1102.5607	
G2	EB BATTERIEPACK 13,2V 6AH BATTERY PACK NUR VAR/ONLY MOD: 12	1102.5607.00	BATTIV	1102.5607	
G3	EB BATTERIEPACK 13,2V 6AH BATTERY PACK NUR VAR/ONLY MOD: 12	1102.5607.00	BATTIV	1102.5607	
J2	ZM PEGELINSTRUMENT	1102.4981.00			1102.4746.01
W1	DW HF-KABEL W1 RF CABLE W1	1082.8165.00			1102.4746.01
W2	DX BATT.KABEL BATTERY CABLE NUR VAR/ONLY MOD: 12	1102.6161.00			
W4	DV HF-KABEL W4	1102.4600.00			1102.4598.00
W5	DV HF-KABEL W5	1102.4617.00			1102.4598.00
W6	DV HF-KABEL W6 RF CABLE W6	1082.8194.00			1102.4598.00
W7	DV HF-KABEL W7	1102.4630.00			1102.4598.00
W8	DV HF-KABEL W8 RF CABLE W8	1082.8213.00			1102.4598.00

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Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
W9	DV HF-KABEL W9 RF CABLE W9	1082.8220.00			1102.4598.00
W10	DV HF-KABEL W10 RF CABLE W10	1082.8236.00			1102.4598.00
W11	DV HF-KABEL W11 RF CABLE W11	1010.5301.00			1102.4598.00
W12	DV HF-KABEL W12	1102.4623.00			1102.4598.00
W13	DV HF-KABEL W13 RF CABLE W13	1011.2158.00			1102.4598.00
W15	DV HF-KABEL W15 NUR VAR/ONLY MOD: 12	1102.4646.00			
W23	DV HF-KABEL W23 RF CABLE W23	1010.5360.00			1102.4598.00
W42	DY CABLE VGA	1102.4817.00			
W45	ED FILTER BOARD NUR VAR/ONLY MOD: 30	1003.0120.03			
W45	ED FILTER BOARD NUR VAR/ONLY MOD: 12	1003.0120.04			
W52	DX FLOPPY VERSORGUNG FLOPPY POWER	1065.9250.00			
W53	DY FLOPPYKABEL FLOPPYCABLE	1102.4923.00			
W240	DF LCD-ANSCHLUSS CABLE	1102.5620.00	ULTRATRONI	1102.5620	1102.4746.01

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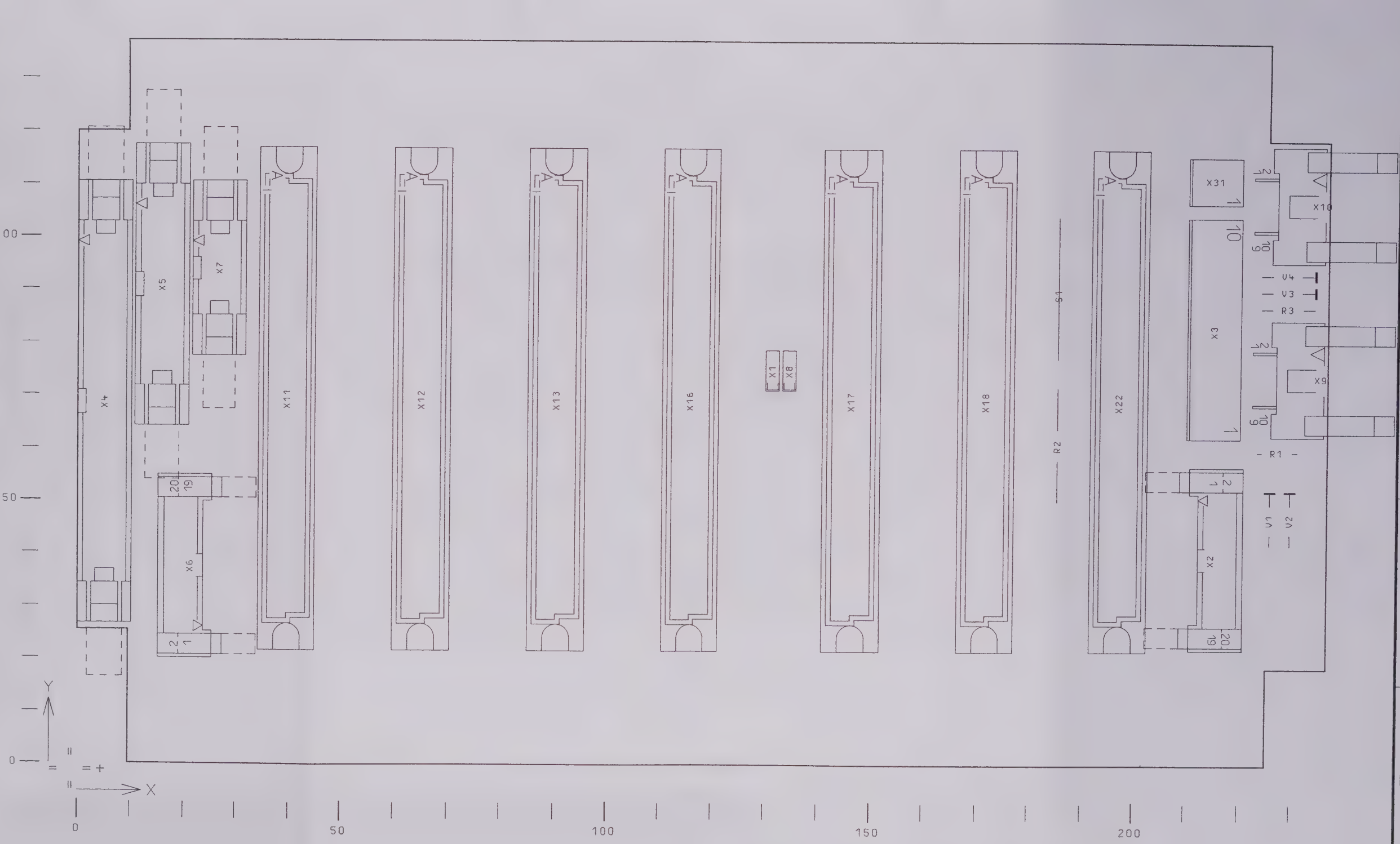
Kennz. Comp. No.	Benennung Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bezeichnung Designation	enthalten in contained in
.	XX VARIANTENERKLAERUNG IDENTIFICATION OF MODELS				
R1	RL 0-OHM-WIDERST. 0204 0-OHM RESISTOR	RL 0069.0000.00	DRALORIC	OMA 0204	
R2	RD 2.4W47 OHM+-1%TK20 WIRE WOUND RESISTOR	RD 0439.5994.00	TEPRO	TS-2B	
R3	RL 0,60W4,75 OHM+-1%TK50 METALFILMRESISTOR	RL 0099.8021.00	RESISTA	MK2 4,75 OHM 1% TK50	
S1	ST TEMP.SCHALT.45GRSCHL TEMPERATURE SWITCH	0801.8325.00	MIDWEST_CO	MTS 45 A	
V1	AD 1N4448 75V UDI DIODE	AD 0012.0700.00	PHILIPS_SE	1N4448 "	
V2	AD 1N4448 75V UDI DIODE	AD 0012.0700.00	PHILIPS_SE	1N4448 "	
V3	AG BYS21-90 SGL 90V 1AO RECTIFIER	0644.5526.00	SIEMENS	BYS21-90	
V4	AG BYS21-90 SGL 90V 1AO RECTIFIER	0644.5526.00	SIEMENS	BYS21-90	
X1	FP STIFTLEISTE 3P.R2,54 PIN CONNECTOR	FP 0009.6101.00			
X2	FP STECKERLEISTE 20P.GER CONNECTOR 20P	FP 0351.3468.00	SIEMENS	V23535-A2200-A202	
X3	FP STECKERLEISTE 10P.GER CONNECTOR 10POL.	FP 0815.7603.00	J_S_T_DEUT	B10P-VH-B	
X4	FP STECKERLEISTE 50P.GER CONNECTOR 50P.	FP 0099.9434.00	BERG_ELEKT	71918-150	
X5	FP STECKERLEISTE 26P.GER CONNECTOR 26POL.	FP 0620.0147.00	BERG_ELEKT	71918-126	
X6	FP STECKERLEISTE 20P.GER CONNECTOR 20P	FP 0351.3468.00	SIEMENS	V23535-A2200-A202	
X7	FP STECKERLEISTE 10P.GER CONNECTOR 10 WAY	FP 0649.4428.00	BERG_ELEKT	71918-110	
X8	FP STIFTLEISTE 3P.R2,54 PIN CONNECTOR	FP 0009.6101.00			
X9	FP STECKERLEISTE 10P.WIN CONNECTOR	FP 0738.5335.00	SIEMENS	V23535-A2210-A102	
X10	FP STECKERLEISTE 10P.WIN CONNECTOR	FP 0738.5335.00	SIEMENS	V23535-A2210-A102	
X11 ..13	FP BUCHSENLEISTE 64POL. FEMALE MULTIPOINT CONNECT	FP 0272.9112.00	SIEMENS	V42254-B2201-C963	
X16 ..18	FP BUCHSENLEISTE 64POL. FEMALE MULTIPOINT CONNECT	FP 0272.9112.00	SIEMENS	V42254-B2201-C963	
X22	FP BUCHSENLEISTE 96POL. FEMALE MULTIPOINT CONNECT	FP 0272.9129.00	SIEMENS	V42254-B2201-C960	
X31	FP STECKERLEISTE 2P.GER CONNECTOR 2POL.	FP 0815.7584.00	J_S_T_DEUT	B2P-VH-B	

Für diese Unterlage behalten wir uns alle Rechte vor.

DIESE ZEICHNUNG IST EIN RECHNERAUSDUCK. AENDERUNGEN KOENNEN NUR DURCH AENDERN DES DATENSATZES ERFOLGEN



DARSTELLUNG SEITE B
VIEW ON SIDE B

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
ATTENTION ESD!
ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

BINDENDE ANGABEN UEBER VARIANTEN, TRIMMWERTE, BAUTEILWERTE UND NICHT BESTUECKTE BAUTEILE SIEHE SA.

FOR BINDING INFORMATION ON MODELS, TRIMMING AND COMPONENTS VALUES AND NONFITTED COMPONENTS SEE PARTS LIST.

AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME
02/		04.07.97	WY
/			

	TAG	NAME
MENP		
BEARB.		WY
GEPR.		
NORM		
PLOTT	23.07.97	

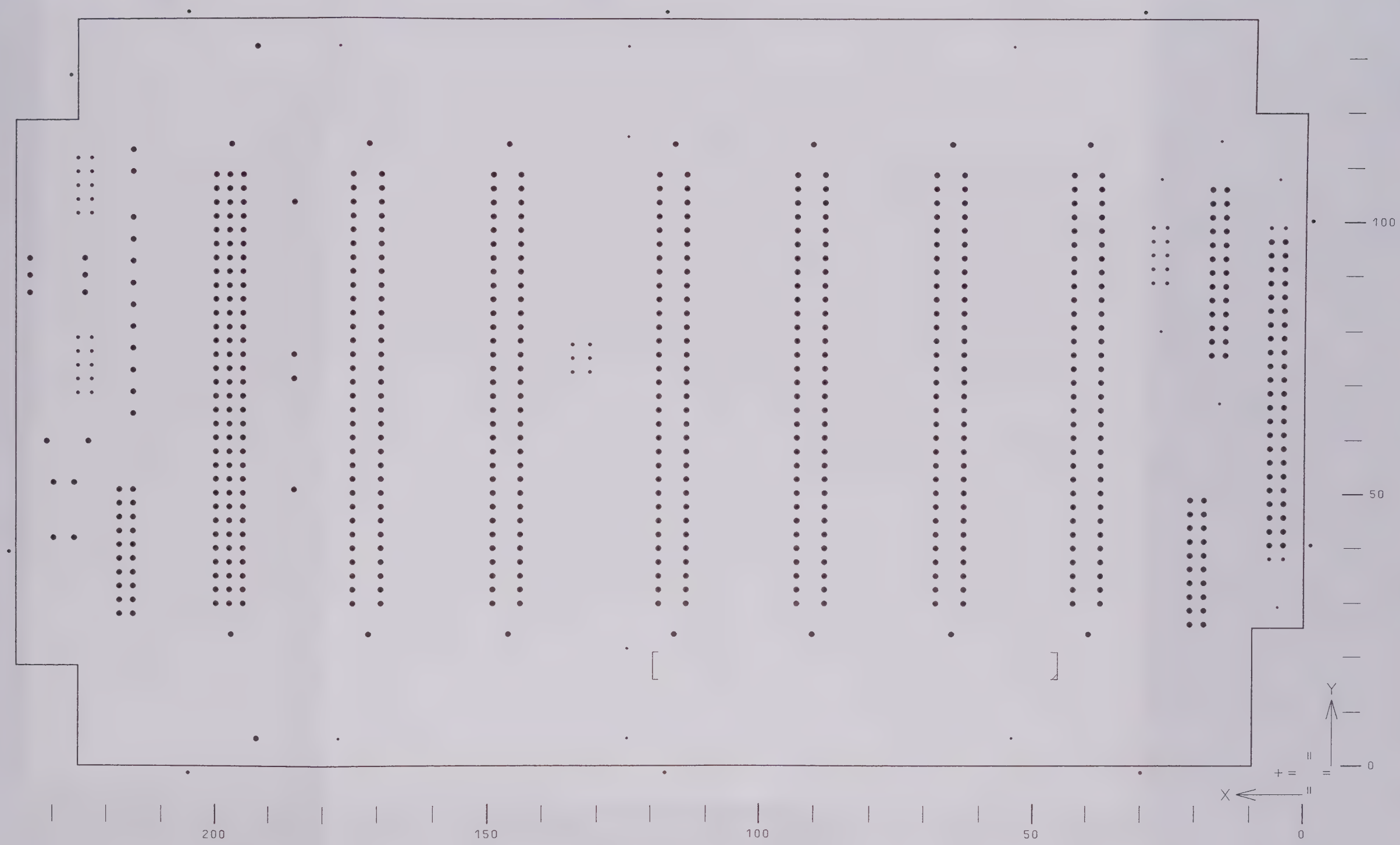
ROHDE&SCHWARZ
ZU GERAET ESCS

BENENNUNG: MOTHERBOARD — Z

ZEICHN.-NR. 1102.4698.01 ED — BLATT-NR. 1+

REG.I.V. 1102.4500 — ERSTE Z. 1102.4500

FUER DIESE ZEICHNUNG BEHALTEN WIR UNS ALLE RECHTE VOR
DIESE ZEICHNUNG IST EIN RECHNERAUSDUCK. AENDERUNGEN KOENNEN NUR DURCH AENDERN DES DATENSATZES ERFOLGEN



DARSTELLUNG SEITE A
VIEW ON SIDE A

ACHTUNG: EGB!
ELEKTROSTATISCH GEFAEHRDETE BAUELEMENTE ERFORDERN EINE BESONDERE HANDHABUNG.
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ELECTROSTATIC SENSITIVE DEVICES REQUIRE A SPECIAL HANDLING

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AEND. IND.	AENDERUNGS-MITTEILUNG	DATUM	NAME
02/		04.07.97	WY
/			

	MENP	TAG	NAME
BEARB.			WY
GEPR.			
NORM			
PLOTT	23.07.97		

ROHDE&SCHWARZ
ZU GERAET ESCS

BENENNUNG: MOTHERBOARD — Z

ZEICHN.-NR. 1102.4698.01 ED — BLATT-NR. 2- — V. BL.

REG.I.V. 1102.4500 — ERSTE Z. 1102.4500

Important Hints before Operation:

For instruments without the computer function FSE-B15:

- The disks used must have been formatted by the FSE itself or by MS-DOS. Pre-formatted disks can cause errors.

For instruments with the computer function FSE-B15:

- The drives D: and Q: are reserved for system software and must not be altered. Any changes in the drives D: and Q: can cause function errors.
- When operating a PS/2 mouse, a mouse driver has to be loaded via the designated entry in the autoexec.bat file.
- The files AUTOEXEC.BAT and CONFIG.SYS are write protected. User-specific programs which are to be executed automatically during the system startup must be entered in the file C:\AUTOUSER.BAT. Network drivers for option FSE-B16 must be entered in the file C:\NETWORK.BAT.
- After switching on the instrument, the startup process can be interrupted if required. This is achieved by pressing any key on the external keyboard repeatedly until "ABORT SYSTEM BOOT [Y/N?]" is queried on the display. The instrument works then in the DOS mode.

For all instruments:

- Aborting a hardcopy is not possible when printout is in progress. Print jobs in the queue can be deleted before printout has been started by pressing the HARDCOPY START key until the message "Hardcopy in progress. Abort?" is displayed. The length of the queue is two jobs.

Safety Instructions

This unit has been designed and tested according to the standards outlined overleaf and has left the manufacturer's premises in a state fully complying with the safety standards.

In order to maintain this state and to ensure safe operation, observe the following instructions, symbols and precautions.

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   Pollution severity 2, overvoltage category 2, IP degree of protection 2X, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made (installation and cabling of the unit to be performed only by qualified technical personnel).

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device.

In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.,

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

10. Any additional safety instructions given in this manual are also to be observed.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions

Weight indication for units >18 kg

PE terminal

Ground terminal

Danger! Shock hazard

Warning! High temperatures Warning! Hot surfaces

Ground

Patent Information

This product contains technology licensed by Marconi Instruments LTD. under US patent 4609881 and under the corresponding patent in Germany and elsewhere.